SCIENTIFIC AMERICAN
No. SUPPLEMENT, 261

Scientific American Supplement, Vol. XI., No. 261.
Scientific American, established 1845.

NEW YORK, JANUARY 1, 1881.

Scientific American Supplement, $5 a year.
Scientific American and Supplement, $7 a year.

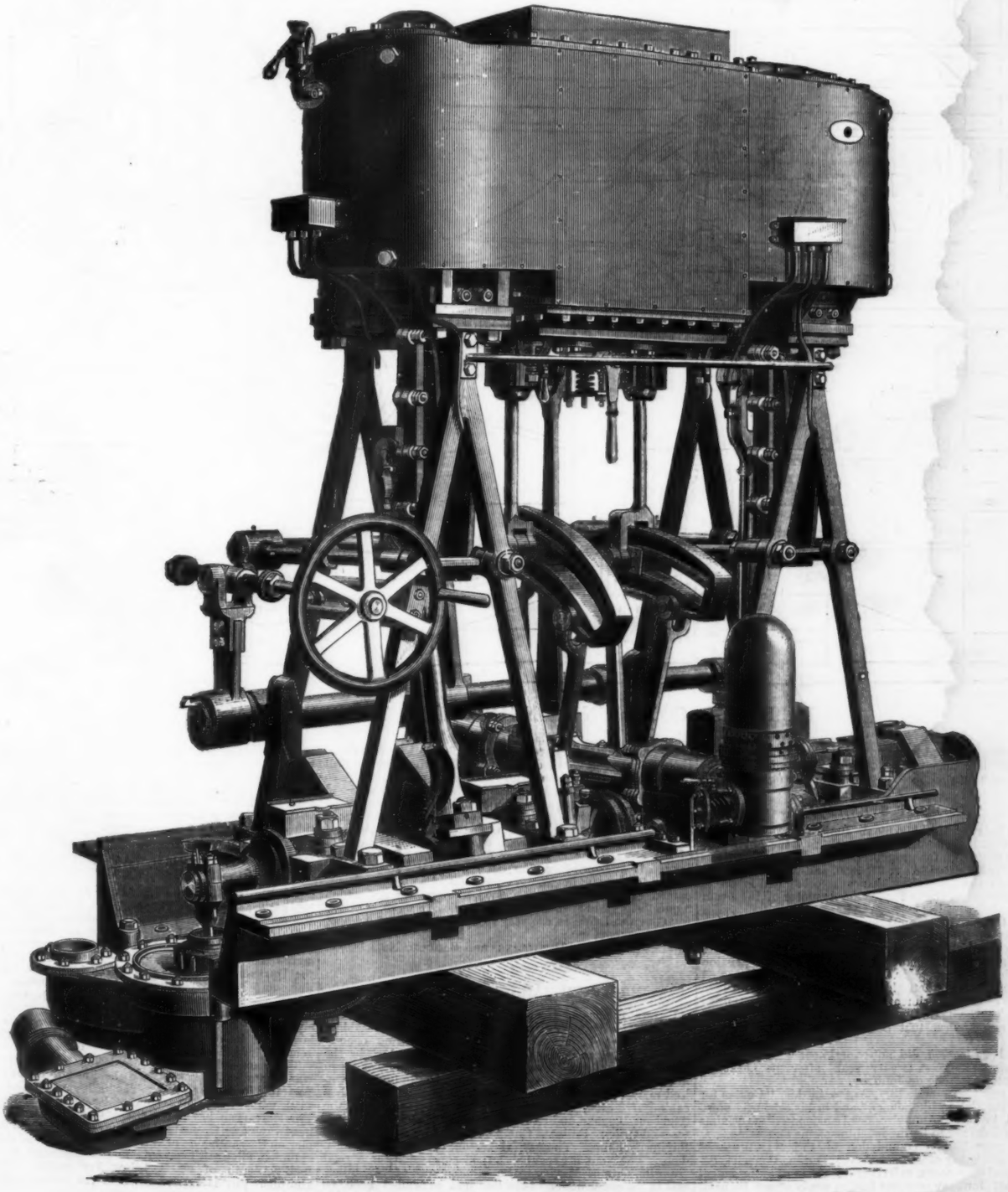
IMPROVED TORPEDO BOAT ENGINES.

We give engravings of a pair of compound surface condensing engines, constructed by Messrs. Augustin Normand & Co., of Havre, for the torpedo boats built by them for the French Government. The perspective view of these engines, which we give on this page, shows their general design, while their arrangement in the vessel is shown by Figs. 1, 2, and 3, on next page, the remaining figures representing details respecting which we shall speak presently.

On reference to our engravings it will be seen that the engines are of the compound intermediate receiver type with cranks at right angles. The high-pressure cylinder is 320 mm. (12·6 inches) and the low-pressure cylinder 520 mm. (20·48 inches) in diameter, the stroke being in each case 380 mm. (14·96 inches). The two cylinders are cast in one piece with their steam jackets and the intermediate receiver, and they are supported on four A frames of steel, arranged as shown. The frames, it will be noticed, are placed so as to leave all parts very readily accessible.

On each side of the base-plate are the feed and bilge pumps, these being worked by an eccentric keyed on the crank-shaft at the middle of its length. The air pump is vertical, and is worked from a crank-pin formed at the fore end of the crank-shaft. The position of the air pump in the vessel, and its connection with the condenser, is shown clearly in Fig. 3.

The exhaust steam escapes through the backs of the slide valves, and the exhaust from the low-pressure cylinders crosses the intermediate receiver, but is well protected from it so as to avoid causing condensation. The condenser is a cylindrical vessel of Muntz's metal, 8 feet 4 inches long by 1 foot 11·6 inches in diameter, the exhaust steam being led down to it by a forked pipe so that it enters the condenser at two points. The condenser is traversed from end to end by tubes through which the water is made to circulate by the motion of the boat. The packing for the tubes consists of a tube of India-rubber, and the holes in the compressing brass plates are countersunk, so as to form nozzles at both ends of the tubes, and so reduce the resistance to the motion of the water. A steam jet is provided in the after circulating pipe, leading from the condenser, for the purpose of



IMPROVED COMPOUND ENGINES FOR TORPEDO BOATS.

producing a circulation of the water during trials at moorings. This arrangement of condenser was applied for the first time by Messrs. Normand in 1875, on board the paddle steamer Hirondelle.

The crank-pins are, as will be seen, of great length, their length being 180 mm. (7·08 inches) and their diameter 90 mm. (3·54 inches). The crank-shaft has four bearings, and, to accommodate the flexibility of the boat and engines, the connecting rods are flattened at one portion of their length, as shown by the detail views, Figs 4 and 5, so as to give them some flexibility in a fore-and-aft direction, and insure good contact between the working surfaces. The flattened portion of each rod measures 3·94 inches by 0·48 inch, and the upper part of each rod is bored out, as shown by dotted lines, so as to lighten it. The general design of the rods is shown clearly by Figs. 4 and 5. All the bearings are of phosphor bronze.

The supply of air to the stokehole is furnished by a fan, driven by a separate engine, as shown in Figs. 1, 2, and 3. The shaft bearings of the engine are also very long, and, to give the plummer-blocks some elasticity, they are made as shown in Figs. 6 and 7. This plan is stated to answer very well.

The engines we have been describing are supplied with steam by a boiler of the locomotive type, 4 feet 7·1 inches in diameter in the shell, and containing 239 tubes, 7 feet 2·6 inches long and 1·58 inches internal diameter. Messrs. Normand have been highly successful in obtaining an economical performance, and in securing a good supply of steam with a moderate air pressure in the stokehole. They report a mean indicated horse power of 440 for one boat and 448 for another; consumption of fuel, 2·42 lb. and 2·67 lb. per hour per indicated horse power.—*Engineering.*

THE FIRST STEAMBOAT.

FROM a letter of Mrs. Marthe de Jouffroy, granddaughter of Count Claude de Jouffroy, it appears that the latter was the first to use steam for propelling a ship.

This letter is dated Aug. 31, 1880, and was written in reference to the festivals which were celebrated in Blois, France, in honor of Denis Papin, the inventor of the steam engine.

We quote from it the most important facts. Fulton has never claimed the priority of the invention of the steamboat. He said in his polemics, commenced 1802, regarding the experiments of Desblanc de Trevaux: "Is it a question of invention? Neither Mr. Desblanc nor I have invented the pyroscaphe. If that glory belongs to any one, it is to the author of the experiments made at Lyons in 1783, upon the Soane." ("Revue du Lyonnais," vol. ix., page 127, article of Mr. Dumas, Perpetual Secretary of the Academy at Lyons.)

Fulton, born in 1765, did not experiment with his steamboat till after 1803, *i. e.*, twenty years after the authentic experiments of Claude de Jouffroy.

In the years 1826 and 1827, Arago, in his "Course for Pupils of the Polytechic School," and in his scientific notes published in the "Annuaire des Longitudes," proclaims Claude de Jouffroy to be the inventor of the steamship.

In the year 1840, a commission of the "Institute of France," consisting of Messrs. Arago, Dupin, Poncelet, Seguier, stated once more, referring to the authentic act at Lyons, that Jouffroy was the first to apply steam to navigation. "His ship, which he used during sixteen months upon the Saone had the same proportions to which we have at present come back in the construction of our best steamships." The same report also mentions that Fulton, who lived for a long time in France, has given credit to Count de Jouffroy.

We annex a literal translation of the authentic act.

Translation of the act, the original of which may be found at Lyons among the papers of Mr. Boissoner, the actual successor of the notaries who filed this act in 1783.—"Before the undersigned king's councils, notaries at Lyons, the following persons appeared: Squire Laurent Basset, late consul of the Court of Exchange, under seneschal's jurisdiction and presidial of Lyons; lieutenant-general of police of said city; the Abbé Monge, chevalier, historiographer of the city of Lyons, member of the Academy of Sciences of that city; Mr. Antoine-François de Sandine, advocate of parliament, member of the Academy of Sciences at Lyons, correspondent of the Academy of Inscriptions and Belles-lettres at Paris, Fellow of the Academies of Dijon and Villefranche; Squire Joseph Mathon, chevalier, courtier, etc., member of the Academies of Lyons and Villefranche; Mr. Claude-Antoine Roux, professor of elocution, late professor of physics and mathematics at the College Royal-Dauphin de Grenoble, of the Academy of Lyons, etc.; Mr. Gabriel-Etienne Le Camus, advocate of parliament, of the Academy of Lyons and of Dijon, correspondent of the Royal Society of Montpellier, and receiver of excises at Lyons; Squire Jean-Baptiste Salicis, curate of the parish of Vaize, one of the suburbs of the city, and Mr. Jean-Baptiste Salicis, nephew, vicar of said parish, all residing at Lyons.

"These same certify and attest that Claude François Dorothee, Count of Jouffroy d'Abbans, invited them on the 15th day of last July, to witness an experiment made in order to move a ship, 130 feet long and 14 feet broad, drawing 3 feet of water, consequently having about the weight of 327,000 pounds, against the course of the Saone, the water of which at that time was about at its medium height, and that Mr. Jouffroy indeed moved this ship without the help of any animal power, and only by means of the fire pump for nearly quarter of an hour, after which Mr. Jouffroy put an end to his experiment. As witnesses of which the above-named gentlemen have requested to sign this act, which request was granted them by said notaries, to serve, etc., etc.

"Given at Lyons in the year 1783, on the 19th of August, in the forenoon, etc., etc.

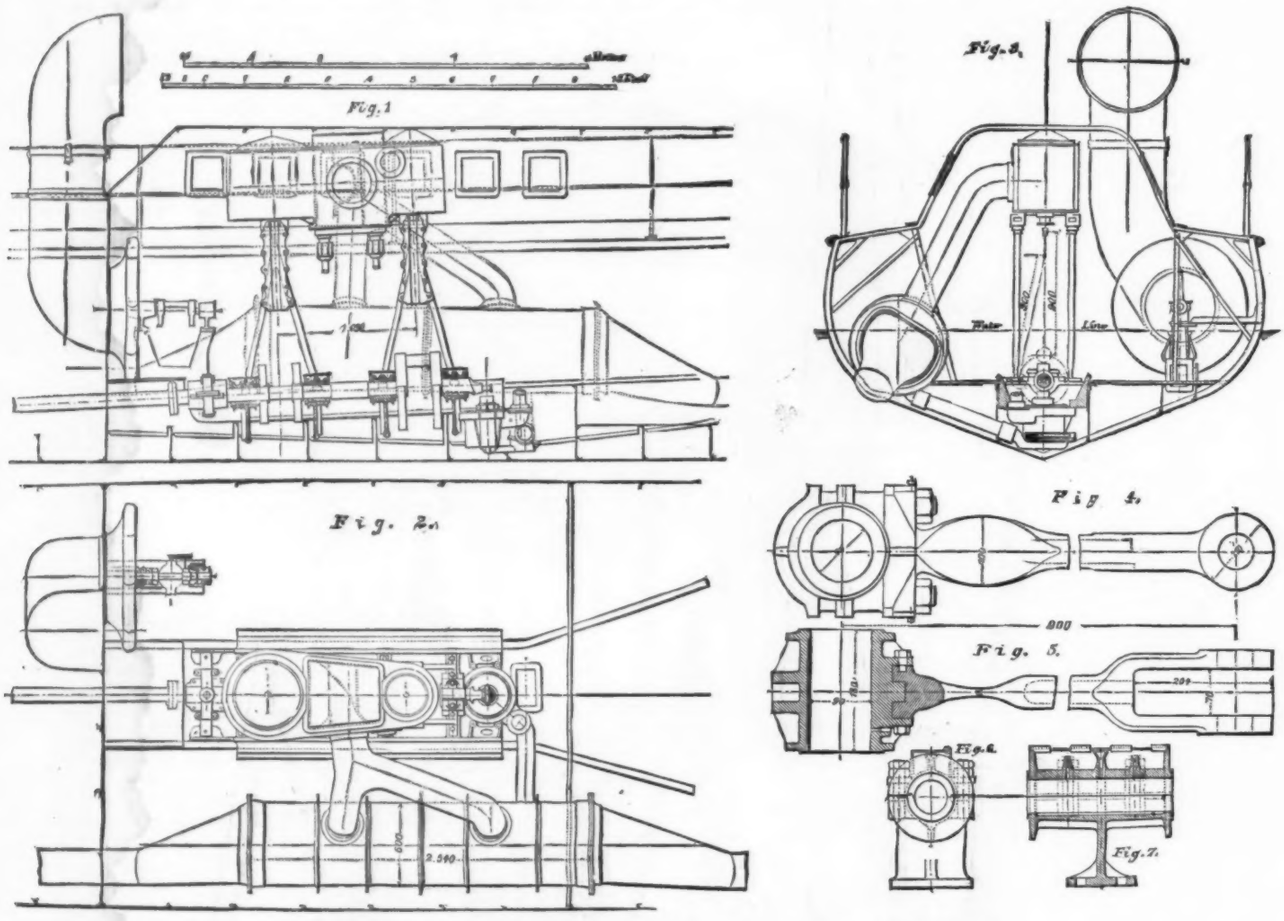
(Signed) "DEVILLIERS and BAROUD, Notaries."

PROPOSED RAILWAYS IN MEXICO.

UNDER the act of June 1, 1880, passed by the Mexican Congress, giving authority to the President and his Cabinet to grant railroad concessions, two decrees granting concessions to American companies have been published in the official organ of the Mexican Government. One was given to the Mexican Central Railroad Company (limited), organized under the laws of Massachusetts last winter, with a capital of $5,400,000, which was taken by friends of the Atchison, Topeka and Santa Fé, and the Chicago, Burlington and Quincy Railroad Companies, and by American and foreign bankers. Thomas Nickerson, of Boston, is president. The company secured an old concession for a road from the City of Mexico to Leon, a distance of 262 miles, and in the construction of the line had expended $800,000 before September. It has received the right to extend this line from Leon, the end of the division now under construction, northward by way of Aguas Calientes, Zacatecas, Durango, San Juan del Rio and Chihuahua to El Paso del Norte on the Rio Grande frontier of New Mexico, where connection will be made with the Southern Pacific of California, now completed to within 160 miles of that point; with the Atchison, Topeka and Santa Fé, now completed to within 100 miles of it; with the Texas Pacific, the Galveston, Harrisburg and San Antonio, and the Sonora Railroads, all now rapidly pushing toward El Paso. The concession also gives the right to build a line from a convenient point between Leon and Aguas Calientes, through Guadalajara to the sea port of Mazatlan, on the Pacific Coast. It is estimated that these lines will comprise a distance of about 1,400 miles.

The second concession has been granted to the Mexican National Railway Construction Company, which is represented by William J. Palmer, president of the Denver and Rio Grande Railroad Company. To this company has been given the right to build a narrow gauge road from the City of Mexico westward through the districts of Toluca, Morelia, and Colima to the port of Manzanillo on the Pacific Coast. It gives, also, the right to build a line from some convenient point about sixty miles from the City of Mexico, northward by San Luis Potosi and Monterey to any point on the Texan frontier between Eagle Pass and Laredo. At this point connection may be made with the International and Great Northern Railroad now under construction southward from San Antonio, and also with a proposed branch from the Galveston, Harrisburg and San Antonio Railroad in extension of that line to El Paso. The company will have a total length of road under the grant of about 800 miles.

In the concessions to both companies the Government agrees that it will not grant subsidies to any other lines within a belt of territory sixty-five miles wide on each side of the proposed lines.

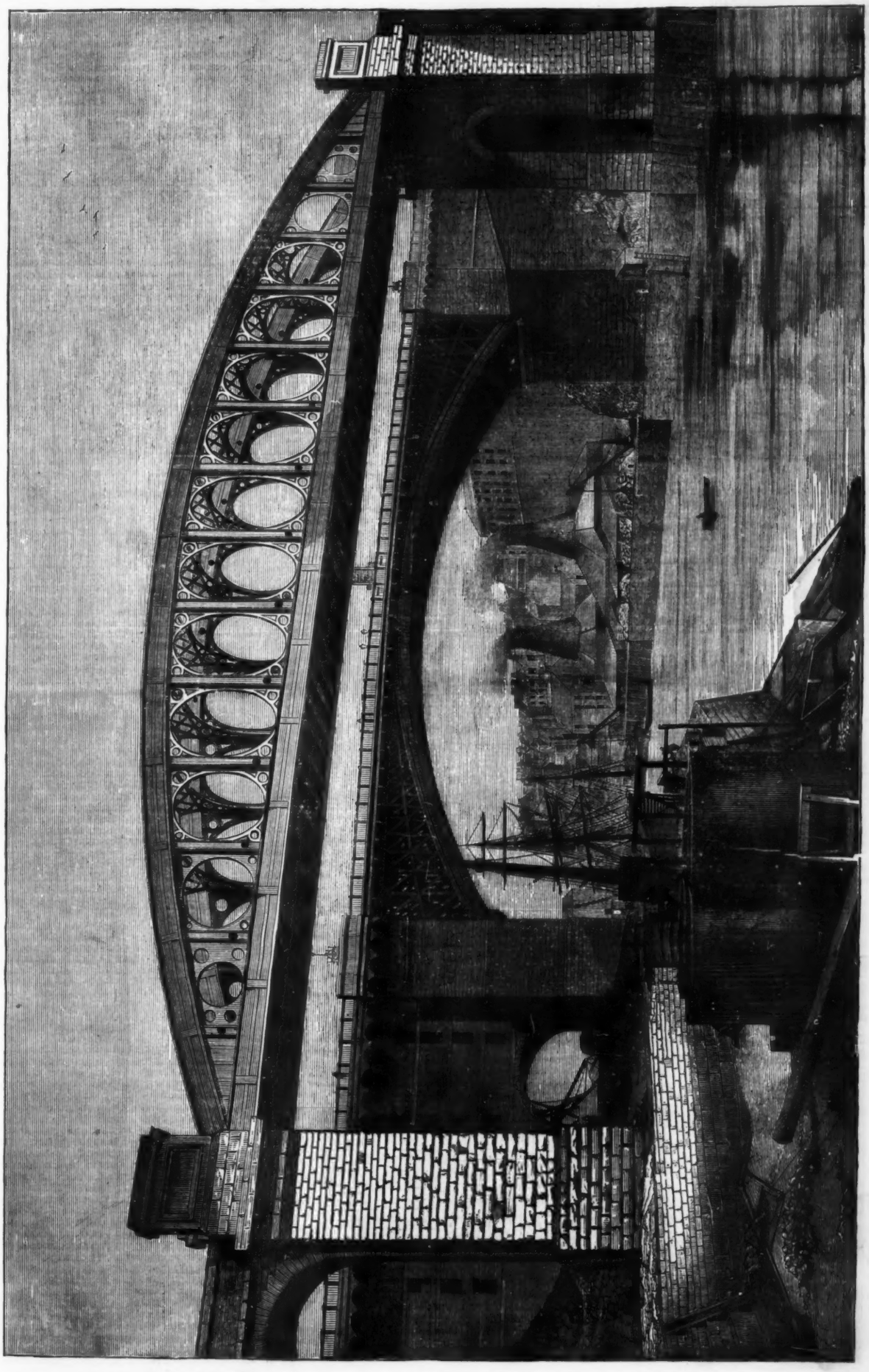


IMPROVED COMPOUND ENGINES FOR TORPEDO BOATS.

NORTHEASTERN RAILWAY—BRIDGE OVER THE RIVER WEAR AT SUNDERLAND.

WE illustrate opposite one of the finest bowstring girder bridges ever erected. This bridge carries the Northeastern Railway over the River Wear at Sunderland. The railway is a junction line 2¼ miles long, from the Monkwearmouth Station on the Newcastle and Monkwearmouth Branch, across the river and through the town to its junction with the Durham and Sunderland Branch near Ryhope. The line comprises three important works, the bridge over the Wear, a new central station, and two tunnels, together over 1,000 yards long. The contract for these works—exclusive of the new station buildings and the purchase of the land—was let to Mr. John Waddell, of Edinburgh, in November, 1874, for the sum of £219,000.

The excavation for the foundations of the new bridge was begun in July, 1875, and the line was opened for public traffic in August, 1879. The bridge consists of one main span, with three 31-ft. semicircular arches on either side. The main span has a clear width of 300 ft., and a clear headway of 86 ft. above high water. The main abutment pier on the south side of the river is founded on thirty 5-ft. cylinders filled with cement concrete and sunk to the solid rock a depth of 28 ft. below low water. The north abutment pier is carried down to the rock at a much less depth.



NORTH-EASTERN RAILWAY BRIDGE OVER THE RIVER WEAR AT SUNDERLAND.

MR. T. F. HARRISON, M. I. C. E., ENGINEER.

The two lines, which are laid with flat-bottomed steel rails, 90 lb. per yard, are carried upon longitudinal sleepers on transverse wrought iron girders, between two bowstring box girders, the depth at the center being 42 ft., the width of the top and bottom flanges of the upper and lower booms being 4 ft., the internal dimensions of each boom, 5 ft. 6 in. by 2 ft. 9 in.; and the weight of each girder a little over 500 tons. Means are provided for getting easily at every point inside and outside the booms, for painting and inspection. The main girders are fixed at one end, and by an arrangement of rollers are free to expand at the other. The total weight of the superstructure of the bridge is 1,069 tons. The bridge was very severely tested at the Government inspection by Major Marindin, R.E., on the 24th July, 1879, with the following results: When loaded with engines throughout its entire length the bridge carried a live load of 810 tons, made up as follows: On each line, 1 tank engine, 45 tons; 6 goods engines, with loaded tenders, 360 tons; total, 450 tons on each line.

The following deflections were noted:

Main Girders.

	West girder.	East girder.	Expansion at free end.
	Inch.	Inch.	Inch.
One tank engine on each line, at center, deflection	⅜	¼	1/16
permanent set	Nil.	Nil.	1/16
Three engines on each line, deflection	1	1¼	¼
permanent set	Nil.	¼	1/16
Seven engines on each line, deflection	1⅜	1¾	¼
permanent set	¼	⅜	¼

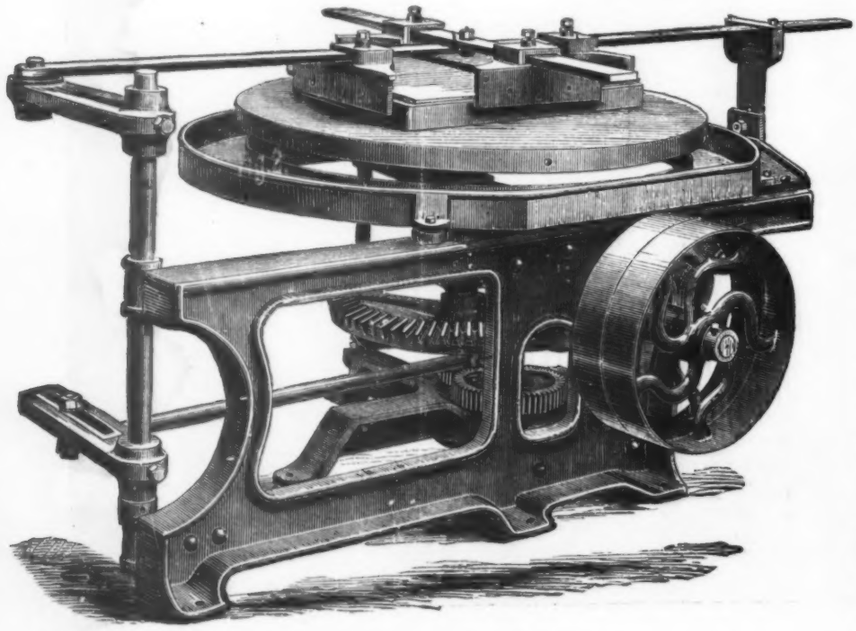
The deflection of the transverse girders was, with tank engines, 17 tons on the driving wheels, ½ in., of which—at the center—one-sixteenth is due to the deflection of the main girders. The girders were constructed by Messrs. Hopkins, Gilkes & Co., of Middlesbrough. The works were designed by Mr. T. E. Harrison, and carried out under his supervision by Mr. F. S. Kelsey and Mr. Cecil Johnstone, resident engineers.

The new station is situated in High Street, where the railway is in a deep cutting, the platforms, which are over 600 ft. long, being about 16 ft. below the level of the adjacent streets, and approached by broad flights of steps from the station buildings and cab stand, which are on the level of street. There are four lines of rails through the station, and the entire length of the platform is covered by a roof 96 ft. span.

The new bridge stands side by side with Robert Stephenson's celebrated road bridge, which is shown in the background of our engraving. This bridge was first constructed by Thomas Payne. It was formed in part out of another, put up at the Yorkshire Stingo, Lisson Grove, and afterward carried back to Rotherham. It was opened in 1796. It was composed of one arch, the segment of a circle, the chord being 236 ft., and the versed sine 34 ft. This bridge was rebuilt, as shown, by Robert Stephenson.—*The Engineer.*

SALMON & CROSSLAND'S STONE GRINDING AND POLISHING MACHINE.

A VISIT to any lithographic stone preparing works, where the grinding and surface polishing are effected by hand, is sufficient to show that the process is one which it is somewhat difficult to supersede by mechanical operations. By application of the principle of the speculum grinding machines of Lord Rosse and of Mr. Howard Grubb and others, however, a machine has been produced by Messrs. Salmon & Crossland, and made by Mr. J. Salmon, of 12, Parsonage, Manchester, which seems to meet all requirements, the slow compound angular and reciprocating motion given to the stone in the manner easily to be gathered from the accompanying engraving, combined with the revolution of the table, insuring the uniformity in grinding rapidity which is necessary to the production of a level surface on a stone, so that the loss of time in "making ready" is avoided. It is, of course, necessary that the table of the machine on which the grinding and polishing is performed shall be of large size compared with the size of the stone, otherwise the velocity of movement of the table differentiating from 0 to x at the center and the periphery will cause the stone to be ground away less toward the center than at the outside. By giving the stone large transverse travel across the table this difficulty may, of course, be largely removed, but not so completely as by having both large transverse travel and large diameter of table. The machine is capable of many applications, and requires no skilled labor to work it.—*The Engineer.*



SALMON & CROSSLAND'S STONE GRINDING AND POLISHING MACHINE.

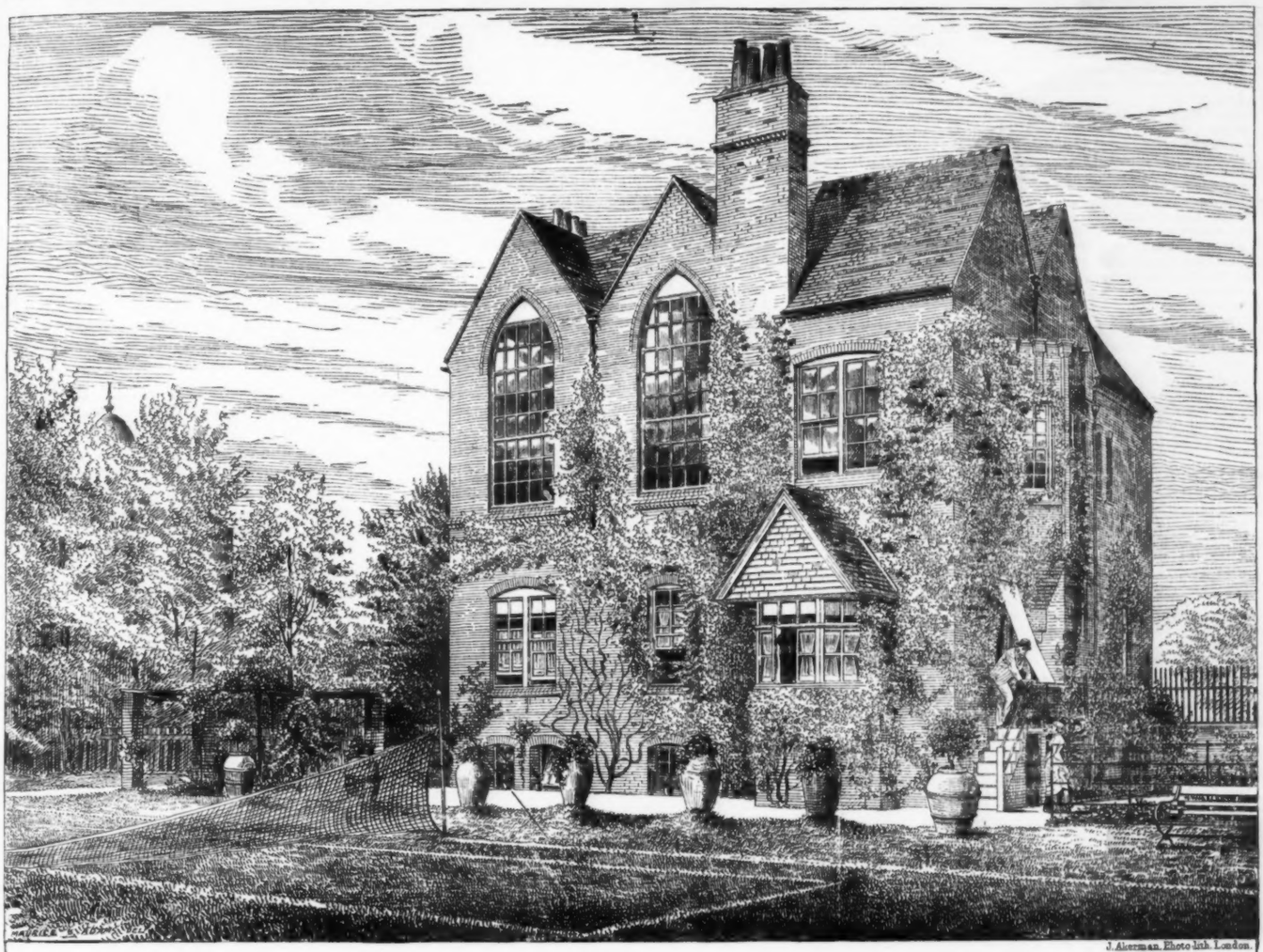
A MINER'S DARING AND ENDURANCE.

THE *News* of Gold Hill, Nevada, relates an instance of rare personal bravery which occurred recently in one of the Comstock mines. The pump column in the mine having burst, the flow of water which is usually pumped at the Hale and Norcross, a large portion of which comes from the well-known north drift on the 2,200 level of the Savage, and is very hot, was sent through connections to the C. N. S. shaft to be raised to the Sutro Tunnel level. One day this flow of water was unusually strong. The pumps labored assiduously to keep it down, but labored in vain. Bailing tanks were added, and still the accumulation could not be kept down. When the 2,400 station at that shaft was some three feet under water, information was sent to the Hale and Norcross of the fact, and a desire was expressed to know the cause of the increased flow. The necessity of an investigation thus became imperative. . . . Superintendent Deidesheimer, not knowing what might have happened in that confined locality to threaten the safety of the mine on the lower levels, and not wishing to send men where he was unwilling to go himself, sent for Foreman Kellogg, who was working on the broken pump column, informed him of the situation of affairs, and asked him to go with himself and see what was wrong. Mr. Kellogg would not allow Mr. Deidesheimer to incur the risks of the exploration, and set about preparing to go alone. He saturated a woolen shirt with ice-water and bound it on and over his head, leaving but a single eye exposed. He then muffled both hands, and, thus prepared, entered the drift, leaving with the superintendent a request that, if he did not return in 15 minutes, the drift should be closed behind him, to be opened no more. This could well be done, as the Savage had bulkheaded that level, the air had been shut out, and the workings were practically abandoned. After enduring that terrible heat for 12 minutes, Mr. Kellogg came back and reported nothing amiss. The extra water was but an unusually large intermittent flow from the old north drift in Savage. When stripped of his mufflings, Mr. Kellogg found that in some way one of his hands had become bared while he was in the drift, and the back of it had been burned to a solid blister by the dry, hot air to which he had been exposed. Water boils on the Comstock at 198°, and he had sustained for 12 minutes a temperature of only 40° below that of boiling water.

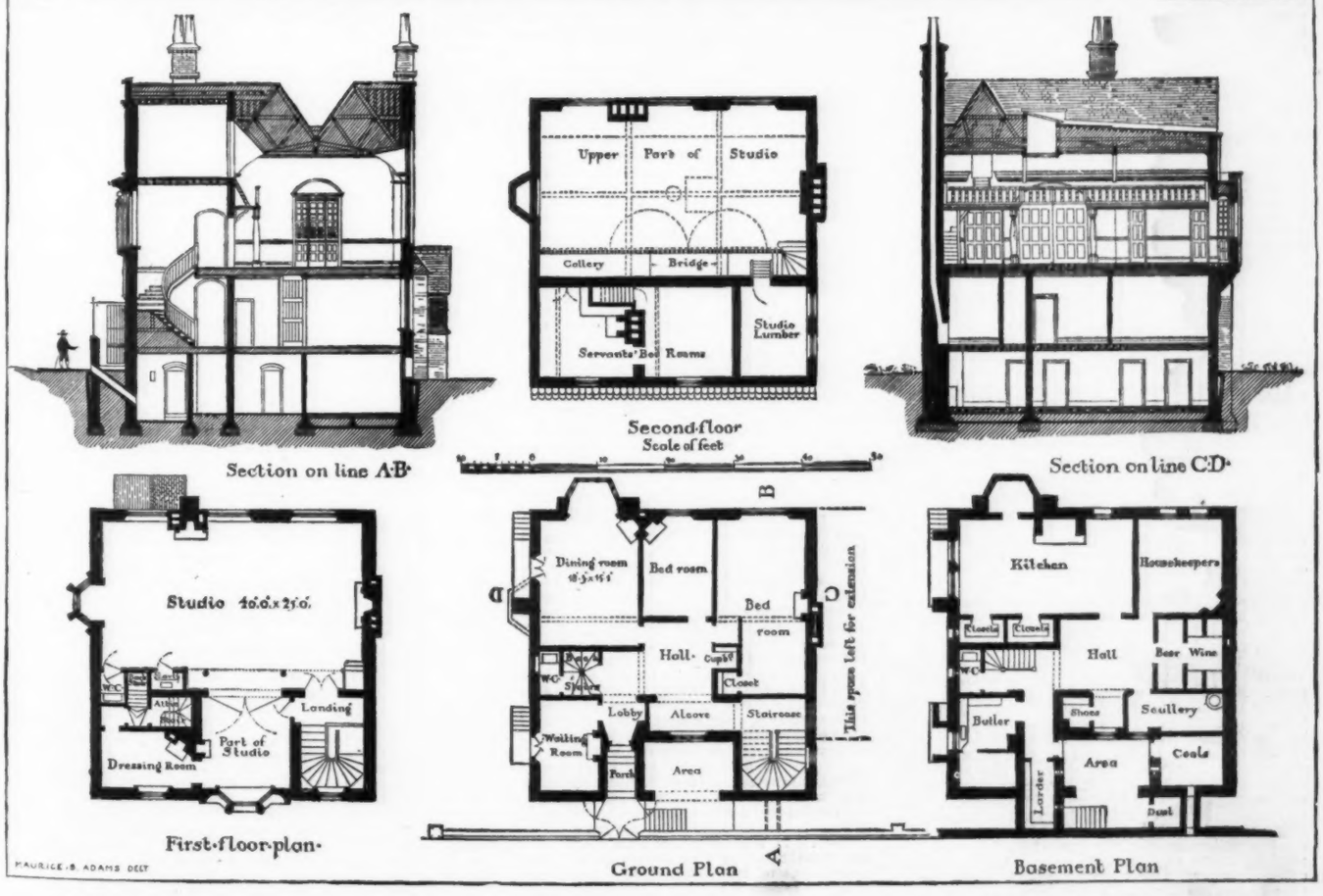
ARTISTS' HOMES, No. 8.

MR. VAL. C. PRINSEP'S HOUSE, KENSINGTON.

NEXT to Sir Frederick Leighton's house, which furnished the subject for our last "Artists' Homes" drawings, is the interesting studio which we illustrate opposite. This residence and studio for Mr. Val. C. Prinsep, A.R.A., was built some fifteen years ago from the designs of Mr. Philip Webb, an architect whose connection with the revival of simple brick architecture for domestic purposes dates probably earlier than that of many whose names are more generally associated with the movement. This house, in fact, was the first artist's house of its kind erected in London, and therefore our illustrations of it have a special interest. The general character of the design facing Holland Park road is well suited to a street frontage, and is conspicuous for an entire absence of ornament, depending chiefly on the singularly recessed oriel over the arched area which continues up to the first floor, and on the pointed-arch entrance porch, for its effectiveness, the whole design on this elevation being governed by a projecting cove or cornice, which is covered by red pantiles in a singularly original manner. Of the garden front we need say but little, inasmuch as the view herewith published will enable our readers to study it for themselves. The plans accurately illustrate the house, and show an ingeniously worked-out example of what may be developed within the lines of a rigidly square plan. The chief entrance is by the acutely-pointed arched porch already referred to, and rising up a flight of some seven stone steps. This porch is vaulted over in red brick, and has a quaint little window on the east side. The front door is simply of plain boarding on the face, without panels or apparent constructive framing. A fine old bronze knocker, enriched by dolphins, and a nude statuette, of Italian character, in its center, form the only relief or furniture provided beyond the thin brass loop handle with which the door may be pulled to on leaving. Entering the lobby, a waiting or garden room is conveniently placed for visitors or for business transactions. The back staircase, well screened, is planned for ready service both to the dining-room as well as entrance. Leaving the lobby, a spacious and well-lit hall offers a thoroughly homelike reception, furnished as it is with quiet hangings and parlor-like chairs and side-tables. In the center a well-grown India-rubber plant flourishes in a remarkably big Japanese pot in blue, and on the walls, besides a series of large photographs from the old masters, is hung a handsome collection of old plaques in blue as well as color. Indeed, Mr. Prinsep has made old china a very favorite hobby, and the specimens which he has brought together show to advantage in his hall and staircase at Kensington. This latter feature in the house may be said to be specially successful, and notwithstanding the many winders, the stairs are "easy going" and spacious. On the angle shelves, or rather small corner landings, stand two handsome brass pots, of grand dimensions, and, instead of a balustrade below the handrail, the space is filled in with plain boarding and covered with Japanese leather paper. Mr. Prinsep was one of the earliest to use this material, and obtained it specially from Japan, using it throughout the house for the principal room-door panels and for dadoes. At that time Japanese leather paper could only be had in small squares, and so its original quaintness for large surfaces is greatly increased by the varied character and color which the many small sheets insure—a variety which is almost entirely lost when continuous paper, such as that now imported from Japan, is used. Plain clear glass is employed for the staircase, as to all the windows, which are everywhere draped with Morris-like patterned stuffs and short cottage or hour-glass blinds. Beyond the staircase a doorway is built in for future extension. The drawing-room occupies the apartment originally used, and so figured on our plan as dining-room. This chamber is of good size, being 18 feet 3 inches by 15 feet 1 inch, exclusive of the deeply-recessed bay, which is most happily treated with seats and a cupboard by the side of the fireplace. The walls are hung entirely by rich and old Italian tapestry, bought by Mr. Prinsep when traveling in Italy. Blue plates are arranged over the opening to the bay recess, and wood brackets and a girder form a sort of alcove at the entrance end. The furniture agrees with the character of the room, but calls for no special remark beyond, perhaps, the little point which strikes one as being unusual in houses of this kind—namely, that the framing of the cane-bottomed chairs is entirely gilt. The mantel-piece is of painted wood, in dark green, like the rest of the joinery, and one of Mr. Philip Webb's well-known grate fronts and tiles completes the fireplace. The side cabinets and tables are used for the display of many choice works of art, old china, and knick-knackeries, collected in India and from all parts of Europe, as well as from Japan. The small room next the last, called, on the plan we give, a bedroom, and at first so used, is now occupied as a dining-room. It is of snug proportions, and with its old Chippendale chairs and sideboard is exceedingly comfortable. The bedroom on this floor is roomy and spacious, the bed being cosily recessed in the inner division, as it were, of the room. The main idea of the house concentrates, of course, in the studio, which is 40 feet long by 25 feet broad, having besides this an adjoining room, connected by big folding-doors, reaching the entire height. Considerable extra space is thus available, and it was here that Mr. Prinsep's huge picture, exhibited this year at the Royal Academy, of the "Delhi Imperial Assemblage, held by Lord Lytton," was painted. The canvas in that case had to be fixed to a strainer composed of three distinct frames, so that each portion of the picture might be brought directly toward the light to be painted, and this was managed by folding the three frames backward triptych fashion, and when completed the picture was opened out, and tightly strained by means of rails behind. The upper parts of the canvas were painted from the gallery, the drawbridge allowing the work to be carried through both rooms, while the gallery front at this part folds back, as shown by our second-floor plan and C D section, leaving a clear passage. The studio has three large windows on the north side, with an oriel at the end, and all these are seen in our perspective view. A top light is arranged over the central north window, and a second skylight is provided in the center of the ceiling, but this latter is not often used. A store-room for artists' properties and studio lumber is arranged on the second floor, and reached from the gallery. The third window to the east is made to take out for the removal of large paintings. A dressing-room adjoins the ante-room, and the back stairs to the servants' rooms are planned behind. Models usually come up the main staircase. The woodwork in the studio and house throughout is painted a dark brown, of no particular tint, and the walls are papered with Morris papers. The studio walls are distempered, salmon red, and the gallery front and columns are of oak, unvarnished. The heating is by means of open grates, hot water pipes having been given up as a failure. The gas-lighting is by two sun-burners, and a second glazing in large sheets is used for the big windows, to exclude as much as possible the cold air in winter. The kitchen and offices are arranged in the basement, which is carefully shown both by the sections and plan. Red brick is entirely used for the walls of the house, and red tiles for the roofs. The external woodwork is colored white, and the ironwork a dark brown. The railing next the street is very massively treated, and looks unquestionably well, although it is entirely plain. Some alterations have been made since the house was built; but as now illustrated it cost rather less than £3,000. Our view is from a photograph taken for us specially by Mr. Bedford Le Mere, and we are indebted to the architect for the particulars from which our general drawings were made.—*Building News.*



J. Akerman. Photo-lith. London.



ARTISTS' HOMES No. 8.—MR. VAL. C. PRINSEP'S STUDIO AND HOUSE, HOLLAND PARK, KENSINGTON.

PHILIP WEBB, ARCHITECT.

THEORIES REGARDING A GRADUAL DEVELOPMENT OF THE SENSE OF COLOR.

THE theories regarding a gradual development of the sense of color, and which maintain that a man in earlier times was not able to discern all colors which are at present known, has been criticised within the last few months by a number of German scientists, and it seems that Mr. Lazarus Geiger, of Germany, and Mr. Gladstone, of England, who chiefly defended these theories, have built their proofs upon a very doubtful basis, as the following will show.

The sense of color is not peculiar to man, but is already developed in the animal kingdom. Dr. Hermann Müller has observed that insects which look for honey and pollen are much more attracted by the color than by the form of the blossoms, so that an insect which derives its nourishment from blue flowers, flies from one blue flower to another, whether they be of different shapes or not. Sir John Lubbock has, by careful experiments, been led to the persuasion that many insects have a highly developed sense of colors. Besides, we can scarcely assume that the brilliant colors of butterflies and birds should have no influence upon their sense of sight; many birds are actually vain of their colors, just as horses and dogs when ornamented with colored drapery. The sense of color seems, therefore, to be a general peculiarity of the organ of sight, which was developed very early in the animal kingdom long before the evolution of man, and it is scarcely probable that a faculty possessed by so many animals should not be found to exist in the human race.

Another discovery which seems to refute the above theory is the following. Krause shows that even in the most ancient times, in the older monuments of writing, the beauty of a gem is praised the color of which approaches the extreme limit of color development, viz., the indigo blue *lapis lazuli*, the *vaiduria* of the ancient Indians, the *sapphire* of the Bible and of the ancient writers. In antiquity no gem was so famous and none was so much sought for in mining and in commerce as this one. But aside from its beautiful color it has no other preference; it is opaque, without play of colors without any remarkable gravity, and its color, therefore, was the only thing which could excite admiration, consequently it must have been known by the civilized nations of that period. The light blue and the greenish turquoise were also known by the ancients; the Bible often speaks of it, and the sapphire was, according to this book, as the sweet Song of Solomon shows, considered to be the most beautiful of gems. Another gem often mentioned in the Bible is the amethyst; but as regards the turquoise and amethyst, the proof against the Gladstone hypothesis is not very strong, for the reason that they are mentioned in books which have been discovered to be of comparatively recent origin; the Song of Solomon can be hardly a hundred years older than our Christian era. But the example of the lapis lazuli may be considered a good proof against this hypothesis. Geiger says that the heaven is never called blue in the Bible. This is an error, for in the second book of Moses, xxiv. 10, we read the following words. "And there was under his feet as it were a paved work of a sapphire stone, and as it were the body of heaven in his clearness." It is true that here the word blue is not mentioned, but we have the fact. Do we express ourselves differently in the nineteenth century if we call a thing violet? We have no especial name for violet, and if we designate something with violet we mean that it has the same color as the violet. But to draw from the fact that the Bible has no special word for blue the conclusion that blue was unknown is just as erroneous as if, two thousand years from now, people were to make the assertion that the nations of the nineteenth century A.D. did not know violet because they had no special word for it.

Archæological studies speak also against the Gladstone-Geiger hypothesis. The renowned Egyptologist, Dümichen, of Strassburg, when questioned in regard to this hypothesis, said the following:

"If Geiger, before he established his theory, had looked at the Egyptian frescoes, he would have discovered that the ancient Egyptians were very capable of discerning even the finer shades. Besides, the Egyptian language has a whole series of words for denoting different colors. Among those words the meaning of which is at present undoubted, we mention: *hat*, clear, white; *kem*, dark, black; *toscher*, red; *maresech* (preserved in the Koptic word *mernech*), reddish yellow; *tehen*, a light yellow; *nat*, green (this word means at the same time "to sprout" and "to be strong"); *mafek*, another shade of green, at the same time the color of the emerald and of a glass flux having a color similar to the emerald; *chesteb*, blue, originally the color of the lapis lazuli; *nub*, golden, gold colored; *hat-nub*, silver and silver colored. In the inscriptions the colors are often even more distinctly described, and to black and white the word *necht* is frequently added, which means *strong, very*."

Professor Dümichen refers, besides, to an old Egyptian palette which is in the Berlin Museum. This palette has seven cavities which contain these seven more or less recognizable colors: black, dark blue, red, light blue, green, yellow, and white. From these seven colors a great variety of shades were produced by mixture, as the Egyptian fresco paintings show. "Trees and shrubs," writes Professor Dümichen,* "are always represented with green leaves, the trunk and branches having a yellow or brownish color. In ships the hull and the masts have also a yellow or brown color; the sails are white; the water of the Nile, the channels, and the ponds, is represented as blue; while the waters of the sea sometimes have a greenish color. Pasturing cattle are painted red, brown, white, and spotted; the colors are exceedingly natural, and so are those of gazelles and antelopes, which are painted with black horns, while the grass which they eat is green. Panthers and leopards appear yellow, with reddish-brown or black spots, the lower part of the belly is mostly painted in a lighter color than the back. The lion is represented yellow, having a somewhat darker mane. Monkeys are painted mostly with a greenish color (similar to the *Cercopithecus griseoviridis*). In pictures, where the offerings of tribute are painted, the elephants have white teeth; ebony-wood has a black color; ostrich feathers and eggs are white; gold rings are yellow or reddish yellow; silver rings white; and copper is red. The blades of knives and swords, the lances and arrow points, the helm and breast plates, are painted either blue or red, indicating in the one place iron and steel, and in the other copper. Negroes, Nubians, Egyptians, Asiatic Semites, Lybians, and northern nations are carefully distinguished by their complexions, which vary from the darkest black to our flesh-color. In regard to the Egyptian sense of color, some representations of brick manufacture, in which the mass which is put into the moulds represents very truly the gray-blue color of the slime of the Nile, while the wooden moulds for the bricks bear a distinct wood color, are especially instructive." According to this testimony, which shows conclusively that the old Egyptians understood colors very well, we will have no right to maintain that at the time of Homer, *i. e.*, about a thousand years later, men were blue-and-green blind.

* "Kosmos," vol. I., p. 490.

But we still have the fact before us that the language of Homer does not contain expressions for the different colors, and this has to be confuted in order to take the last hold from the Gladstone-Geiger theory. This fact loses its weight by the following explanation. We have seen above, in the case of the sapphire, that language needs no special words to express certain colors, but that it is sufficient to use the name of objects which have this color. The sky is like sapphire: that means that the sky is blue. In a similar manner Homer uses the word ocher in the sense of ocher-colored, and leek for leek-colored, indicating a light green, just as he uses the word rose for the red of the dawn. This use of language is not peculiar to the Homeric age. If we investigate the origin of the names of colors we find it is everywhere the same. For many colors we have not, even in our time, a special name; we are satisfied in using the names of the colored objects. Orange and violet are, as names of colors, comparatively new, although they are important colors of the spectrum. Lilac and pensée have a still more recent origin. Should we now draw the conclusion from this that the colors of oranges, violets, pansies, and lilacs have not been hitherto discerned by the eye of man? Certainly not.

At the present time, with nearly every season of fashion, a new color is invented, but no special names are given to them; they are called simply sea-green, navy-blue, Magenta-red, Bismarck brown, etc. We have the colors, but we have no special words to designate them. Krause draws our attention to the fact that the names of colors are closely connected with the inventions for coloring, and that names for the different shades of colors have not been necessary before the nations had reached a certain state of luxury and dyeing had become a profession.

The old Egyptians, as Dümichen has shown, were better dyers than the heroes of Homer; therefore their language is much richer in words for names of colors than the Homeric language. The fact mentioned by Pliny, viz., that originally painters used only cinnibar and minium, may be true, but it only goes to show that red was the only coloring matter known, and does not prove that red was the only color known. New names for colors have only come into use with the discovery of new dyeing substances; and the conclusion which may be drawn from these observations is, that the facts upon which the Gladstone-Geiger theory rests do not prove a gradual development of the sense of color, but simply the evolution of languages.

HOW A FAST RACER TROTS.

AN Englishman who witnessed the recent performance of Maud S. describes as follows her appearance while she was beating the record by trotting a mile in 2:10¾: At her first start she went along with still body and quick legs, head erect, shoulders and trunk immovable except for their forward motion. It was like an opera dancer in a difficult *pas* who confines her action to her feet. Maud S's legs carried her body as if each anatomy was independent of the other. But at the first bend in the track she suddenly broke into a gallop and had to be recalled. Her second start was her successful one. She went round the track like a machine. Her head and back formed a straight line all the way. The eveness was never once broken. It seemed to me as if the pace was all the same, though stop-watches showed that it varied. When she passed the three-quarter of a mile pole the crowd sent up a cheer. "The fastest time ever made!" exclaimed my Jockey Club friend, "1 minute 56 seconds." Turning into the home stretch, the mare came along, evidently quickening her speed, and she was watched in breathless silence, as if the entire concourse was one man watching the seconds on one stop-watch. It was an anxious crowd, its heart beating with hope, as if the fate of a nation depended on Maud S and her driver, whose voice was suddenly heard breaking in upon the general silence. The driver was urging the mare on, not with whip, not with spur, but with an earnest eager cry, to which she responded. On she came, with an easy stride that did not suggest speed so much as grace and elegance. "Hi! ya!" shouted her driver, and the next moment she had passed the wire, or winning post, in a tumult of wild enthusiasm. A negro groom in attendance on the mare flung up his watch and his hat, and rushed after her. A great cry went up all over the place. Ladies waved their handkerchiefs, men flung up their hats and shook hands with each other. "Two ten and a half." "Two ten and three quarters," cried one to another. In the midst of the joyous commotion the mare and her driver came back to be clothed and admired. She was surrounded by a crowd. They raised her blanket to pat her with fond hands. A darky hugged her. One man kissed her. She received these attentions as meekly and gently as a pet pony might submit to the caresses of children.

THE TEA TRADE OF THE UNITED STATES.

IN 1848 there were only thirteen firms who imported teas into the United States, at which time it took teas five months to come from China by sailing vessels, and the cargoes were generally sold upon arrival at auction. In 1850 a first Young Hyson retailed as high as $1.50 per pound, while at the present time a Young Hyson of equal quality can be bought at 75 cents retail. In 1854 a combination was formed among tea importers to sell no Young Hysons below 40 cents per pound, the consequence of which was reduced consumption, a large increase in the importation of low grade Greens, and the collapse of the combination within a year. In 1855 the market commenced to decline, until 1856, when common Young Hysons reached 12 cents per pound. In the winter of 1856–57 there commenced a wild speculation in all teas, until June, 1857, when the common Young Hysons brought 35 cents per pound. In the panic of 1857, however, all that the speculators had made was lost. In 1858 the New York tea market reached a much lower point for fine teas than it had ever touched before, although the low grade Young Hysons did not reach the low figures of 1856–57. In 1862 there was a large advance on all teas, owing to the duty of 15 cents per pound levied upon all descriptions of tea. From 1862 to 1865 the tea jobbing houses increased in number, and tea advanced on an average of 90 cents to $1 per pound, while business between importers and jobbers was transacted through brokers almost entirely, and the jobbers changed the character of the tea trade to a great extent, by becoming speculators in gold, buying teas on time for gold, and selling them for currency. The consequence was that at the close of the war, early in 1865, the China market was very low on a gold basis, while the prices were very high in this country on a currency basis, resulting in large profits to the importers. From 1865 to 1870 the tea market gradually declined in price. During the years 1870, '71, and '72, the average value of tea in the United States varied from 30 cents to 30½ cents per pound. The rate of duty during the time varied from 25 cents to 15 cents per pound, and the revenue received varied from $3,000,000 to $10,000,000 annually. In 1873 the duty on tea was abolished, and during the calendar years from 1873 to 1878 inclusive, its average value varied annually from 24 cents to 38½ cents per pound, and the estimated revenue, which would have been increased by the Government on the basis of former rates of duty, would have been from $8,000,000 to $16,000,000 annually.

JAPAN TEAS.

In 1856 Japan teas were first introduced into this country, and then only 2,000 pounds were imported, although it was not until 1859 that any considerable amount (124,000 pounds) was brought here, resulting in an importation of 240,000 pounds the next season, a mere handful when compared with the 35,030,000 pounds which, it is estimated will be imported into the United States during the season of 1880–81. It was not until March, 1869, that the first cargo of Formosa Oolong was imported into this country. The total number of pounds was about 276,000, a small quantity when compared with the estimated receipts here during 1880–81—13,000,000 pounds.

This enormous increase in so short a time proves that Japans and Formosa Oolongs are the teas that the American taste demands, and that they are going to lead all others in popular favor here. Green teas in this country are losing ground, as there have been as many as 25,000,000 pounds imported in a year, while the highest estimates for this season are 17,000,000. The consequence is that New York controls the Japan and Formosa Oolong markets, and also the China green tea market for the whole world. Below we give the Government official report of the quantities and value of tea imported into the United States during the last two fiscal years ending June 1:

Year.	Imports, Net pounds.	Value.	Pounds. Per Capita.
1879	58,891,535	$14,215,526	1.11
1880	69,894,769	18,983,368	1.40

In addition, we give in detail the estimated importations into this country for the fiscal year ending June 1, 1881:

	Pounds.
English Breakfast	4,000,000
Greens	17,000,000
Japans	35,000,000
Oolongs, Amoy	8,000,000
" Foochow	1,500,000
" Formosa	13,000,000
Total	78,500,000

The bulk of the tea comes to this country via the Suez Canal, for the reason that the freight via San Francisco is about 5 cents per pound gross, while via Suez Canal it is only from 2 cents to 3 cents per pound net. The first of all crops of the different kinds of tea come via San Francisco, on account of the quick passage, the time by that route to New York from China and Japan being only 32 to 34 days, while by Suez Canal 60 days would be required. The time to England is about the same by either route—namely, 45 days or thereabouts. By the above comparative statistics it will be observed that there is a very decided increase in the importations of tea into the United States, and, on account of the comparatively lower prices of the better grades of all kinds, the consumption bids fair to increase, as the best goods at reasonably low prices cannot fail to stimulate the demand from all classes.—*Bradstreet's*.

THE EGG TRADE.

THE egg traffic of this country has risen to an importance which few comprehend. The aggregate transactions in New York city alone must amount fully to $8,000,000 per annum, and in the United States to $18,000,000. A single firm in that line of business East handled $1,000,000 worth of eggs during the year. In Cincinnati, too, the traffic must be proportionately large. In truth, the great gallinaceous tribe of our country barnyards contributes in no small degree to human subsistence, eggs being rich in nutritive properties—equal to one-half their entire weight. Goose, duck, and hen eggs are the principal kinds produced in America. We have nothing, however, like what we are told used to be found in Madagascar, or have been found there, the gigantic moa egg, measuring thirteen and a half inches in extreme length and holding eight and a half quarts. One of these birds, with a single effort, might supply a modern boarding house with omelets for a day.

The perishable nature of eggs has naturally detracted from their value as a standard article of diet. The peculiar excellence of eggs depends upon their freshness. But lately the process of crystallizing has been resorted to, and by this process the natural egg is converted into a delicate amber tint, in which form it is reduced seven-eighths in bulk compared with barreled eggs, and retains its properties for years unimpaired by any climate. This is, indeed, an achievement of science and mechanical ingenuity, and has a most important bearing on the question of cheaper food by preventing waste, equalizing prices throughout the year, and regulating consumption. In this form eggs may be transported without injury, either to the equator or to the poles, and at any time can be restored to their original condition simply by adding the water which has been artificially taken away. The chief egg-desiccating companies are in St. Louis and New York. No salts or other extraneous matters are introduced in the process of crystallizing; the product is simply a consolidated mixture of the yolk and albumen. Immense quantities of eggs are preserved in the spring of the year by liming. Thus treated, they are good for every purpose except boiling. It is a common trick for some dealers to palm off eggs so treated for fresh, so that imposition is easily practiced. In the desiccation process, however, the difference becomes apparent, as from four to five more limed eggs are required to make a pound of eggs crystallized than when fresh are used, and eggs in the least tainted will not crystallize at all.

Some of the most experienced egg dealers declare that there is no profit in raising poultry to compare with producing eggs. A single hen will lay from twelve to fifteen dozen eggs per annum, selling at an average of thirteen cents per dozen, and the birds thus occupied can be housed and fed for less than fifty cents for the whole period. In the

East the price per dozen is much higher. Here we buy them by the dozen. Step into an Eastern produce establishment, and they will sell so much for a quarter of a dollar. There is no reason why the crystallizing process should not become quite general, and egg production stimulated as never before, and the food supply receive larger accession from this source. The already great and increasing consumption of eggs in England and France shows growing appreciation for this kind of food compared with any other. In Lima, Peru, eggs sell at $1 per dozen—equal to $4 per pound crystallized. It is thought that this new process for preserving for utilization the industry of our hens and pullets may be very acceptable, as well as beneficial, in a business and domestic point of view.—*Cincinnati Commercial.*

WHERE THE OLEOMARGARINE GOES.

THE Philadelphia *Record* says that fully 100,000 pounds of oleomagarine are weekly produced at the works on the grounds of the West Philadelphia Abattoir. This is at the rate in round figures of 5,000,000 pounds a year. Four years ago a yearly output of 1,500,000 pounds was sufficient to meet the demand. Now the call is in excess of the supply. A market could be found for 500,000 pounds a week if a sufficient supply of necessary materials were forthcoming. From 25,000 to 30,000 pounds of beef fat, 1,500 quarts of milk, and 1,500 to 2,000 pounds of dairy butter are daily consumed at the works in the manufacture of artificial butter.

Two-thirds of the entire amount of oleomargarine made at West Philadelphia is sent to Europe. London, Liverpool, and Glasgow are the principal markets. A few consignments have been sent to Italy, China, and even to Calcutta, India, but the Europeans do not take kindly to the American article.

A good trade is growing up with South America, and large shipments are made to Rio de Janeiro, Para, and Pernambuco. Some of the West India Islands are also customers. In this country the bulk of the supply is taken by New Orleans, although shipments are occasionally made to New York and Boston. Only a small percentage of the entire production is put upon the Philadelphia market.

The Hollanders are large consumers of oleomargarine, but they do not get the manufactured product in a complete state. Instead, they take the oil before it is churned, and do all the finishing processes themselves. It is shipped in tierces holding 350 pounds, and by this method the thrifty Hollanders save the profit on the salt, milk, and other ingredients which enter into the complete process.

THE TIDE OF IMMIGRATION.

NEARLY half a million immigrants came to the United States during the fiscal year 1879–80. The ports of entry were:

New York, 263,726; Port Huron, 94,375; Boston, 34,062; Philadelphia, 21,727; Baltimore, 17,394; San Francisco, 7,153; all other ports, 18,820. Total, 457,257. There arrived from Europe, 347,747; Asia, 5,839; Africa, 21; America, 101,681; Pacific Islands, 954; all other, 1,015. Total, 457,257. The immigration from Europe was: Great Britain and Ireland, 144,876; Germany, 84 638; Sweden, 39,186; Norway, 19,895; Austria, 12,904; Italy, 12,327; Denmark, 6,576; Switzerland, 6,156; Russia, 4,854; Hungary, 4,363; France, 4,313; Netherlands, 3,349; Poland, 2,177; all other, 2,142; total, 347,747. The immigration from the American continent was: British North American provinces, 99,706; West Indies, 1,351; Mexico, 492; South America, 88; Central America, 44; total, 101,681.

The immigration from Asia was: China, 5 802; India, 21; all other countries of Asia, 16; total, 5,839. Of this number 5,081 arrived at San Francisco; 690 at Astoria, Oregon, and the rest, 68, at all other ports.

Two facts are especially noticeable in this connection: The relatively small number of incoming Chinese, and the large number from Canada. What proportion of the emigrants by way of Port Huron were natives of Canada, or had long resided there, does not appear.

THE POPULATION OF THE EARTH.

THE latest estimate of the population of the earth, by Behm and Wagner, is 1,455,923,000, distributed as follows: Asia, 834,707,000; Europe, 315,929,000; Africa, 205,679,000; America, 95,495,500; Australia and Polynesia, 4,031,000; the Polar regions (Greenland and Iceland), 82,000. Of the principal countries of Europe Germany is credited with 43,900,000 inhabitants; Austria and Hungary, 38,000,000; France, 37,000,000; Great Britain, 34,500,000, and the entire Russian dominions about 88,000,000, of which nearly 66,000,000 are in Russia proper. European Turkey has 8,866,000 people and Asiatic Turkey 16,320,000. Of Asia's population China, with all its dependencies, is reported to have 434,626,000; Japan, 34,338,000, and British India 240,298,000. The United States contains more than half of the American population. British North America has 3,839,000, Mexico, 9,485,000, and Brazil, the most populous of the South American countries, 11,100,000.

Of course, most of these figures are more or less reasonable guesses, accurate countings having been made in very few countries.

CONTINENTAL LIBRARIES.

FROM recent statistics it appears that the following are the numbers of libraries and volumes at present existing in the various Continental countries:

	Libraries.	Volumes.	Per 100 Inhabitants.
Austria.....	577	5,475,798	26 8
France.....	500	4,598,000	12·5
Italy	493	4,349,281	16·2
Prussia.....	398	2,640,450	11
Bavaria.....	169	1,368,500	26·4
Russia.....	145	952,090	1·3
Belgium. ...	105	609,110	10·4

Among the more prominent of the various libraries are the Bibliothèque Nationale of Paris, with 2,078,000 vols. and 86,000 MSS.; the Royal Library at Munich, with 800,000 vols. and 24,000 MSS.; of Berlin, with 700,000 vols. and 15,000 MSS.; of Dresden, with 500,000 vols.; of Vienna, with 420,000 vols.; of Copenhagen, 410,000 vols. Paris itself possesses some very large libraries apart from the Nationale, viz., that of the Arsenal, 180,000; Mazarine Library, 150,000; the Institute, 80,000; the City of Paris Library, 52,000; while in the provinces are the libraries of Amiens, 42,000; Versailles, 41,000; Mans, 41,000; Montpellier, 40,500; Cambrai, 30,000; Toulouse, 30,000.

EXTRACTION OF GREASE FROM WOOL.

ON this subject we find the following interesting information in a recent circular of the Boston Manufacturers' Mutual Fire Insurance Co.:

The quality and kind of oil used for preparing wool is a matter of the utmost importance to the underwriter, as it is spontaneous combustion that has caused the record of losses on woolen mills to be heavier than that on cotton mills; but in touching upon the subject of wool oils we approach a very "touchy" subject. Many of the methods of treating wool are jealously guarded as trade secrets; the composition of several of the mixtures used on wool have been communicated to us confidentially and only in order that we may be assured of their safety.

In respect to testimony, we could summon witnesses to prove conclusively that each oil or mixture now used is the very best for its purpose; and conversely that not one of them is really suitable, some difficulty being found either in respect to safety, to the effect on the fiber, or in the removal, of every oil used.

All or nearly all appear to require a hot solution for their removal, by which the elasticity of the fibers cannot fail to be injured in some degree.

It would appear, according to the evidence and also according to the practice of many of the best manufacturers, that mineral or paraffine oils may be safely and economically used upon wool, either pure or mixed; on other equally competent evidence, that they are utterly unfit to be used and cannot be scoured out, and that nothing but olive, lard, or red oil can be tolerated. The "red oil," so called, is in fact oleic acid, and is subject to impurity if the sulphuric acid used in the process of candle making (of which "red oil" is a subsidiary product) is not sufficiently removed. When thus impure, we understand it to be peculiarly liable to spontaneous combustion.

The mixed oils, sold under fancy names, of necessity consist of combinations of some of the oils above named, to which the natural yolk or grease of sheep's wool is sometimes added; the latter substance being imported from abroad under the name of "de gras," mostly for the use of curriers.

From the standpoint of the underwriter, the use of mineral oil, mixed to the extent of at least 40 per cent. with animal or olive oil, is to be desired; because in such proportion it abates all danger of spontaneous combustion, and does not in that proportion seriously increase the danger if fire occurs from other causes.

If consideration be given to the work done by the oil, the chief reason why olive, lard, or red oil is preferred, aside from the question of economy, may be that they are a little more viscous than the mineral oils. This may be a point worthy of investigation. If the slight viscosity of fatty oil is desirable, it may be obtained in a mineral oil as well. The substance to be desired is, therefore, one that is not liable to spontaneous combustion; that is not readily ignited by contact with fire; that is readily saponified or reduced to an emulsion, and readily removed from the fiber without the use of any high degree of heat, and that does hold the fibers together in the process of manufacture.

Since none of the oils, greases, or compounds now in use fully meet all these conditions, and since the adverse testimony against them all is stronger than that in favor of any one kind, it follows that both the common practice in scouring all washed or unwashed wool, and the common practice in preparing the wool for carding and spinning, are in some degree bad; that they are not consistent with true economy; that they enhance the difficulties in manufacturing and dyeing; and that, if there has been any improvement indicated as being possible by experiments made in a laboratory, from which it is fair to infer that great gain would follow if the theory of the laboratory can be reduced to practice, such experiments deserve the closest attention of all parties in interest.

We therefore beg leave to submit, as the result of our investigation of wool oil, certain propositions. These propositions are submitted only for what they may prove to be worth, and with some hesitation, because none of the officers of the company have ever had any practical experience in the treatment of wool:

Proposition 1st.—The wool now used in this country will yield 45,000,000 lb. of grease that is now worse than wasted; because it, together with all the alkalies used in the present imperfect method of extracting it, is discharged into ponds and streams, polluting them in a manner most dangerous to health.

2d.—All this grease can be extracted more perfectly by the use of naphtha than it can be by the use of alkalies, because this grease or yolk does not saponify or yield readily to alkaline treatment until it is in some degree oxidized by age; for which reason the best foreign woolen fabrics are made from wool a year or more old. On the other hand, the newer the clip the more readily the grease is removed by naphtha.

3d.—The grease and fertilizing material that may be all saved by the naphtha process will more than pay the cost of scouring.

4th.—This process does not require any heat in the application of the naphtha, and only tepid water for scouring, with a little ammonia in it, it being possible to cleanse a single fleece, by careful manipulation, without disturbing the position of the various portions, thus leaving every fiber in a perfect condition.

5th.—A portion of the oil thus extracted from the wool itself, after being in some degree refined and mixed with a small portion of mineral oil, makes a viscous emulsion, absolutely free from tendency to spontaneous combustion and in very slight degree inflammable, meeting all the conditions that are required for preparing the wool for carding and spinning.

6th.—The fiber of wool thus cleansed is in much better condition for spinning than when it has been heated and scoured with alkali. Wool and cloth thus treated are in much better condition for the reception of dyes than is possible under any other treatment.

7th.—This process may be conducted safely in buildings constructed outside mill yards at a fair distance away, but not beyond the distance to which the small amount of heat needed may be carried from the main boilers in underground steam pipes.

In witness of these allegations we present the report of Mrs. Richards, which was first printed in the *Bulletin of the National Association of Wool Manufacturers*, Vol. IX., No. 2.

MRS. RICHARDS' REPORT.

During the progress of the investigation of oil instituted by the Boston Manufacturers' Mutual Fire Insurance Company, for the purpose of abating the danger of fire from spontaneous combustion and other causes, it became expedient to study the natural oil or grease of sheep's wool, which is now saved to a considerable extent in Europe, and imported into this country, under the name of "de gras," for the use of curriers and for other purposes.

The results of our study of this substance, although not immediately bearing upon the purpose of the inquiry, yet may have an interest to the members of the company, especially those engaged in the manufacture of wool, and are therefore submitted.

The preparation of the raw material is a question of the first importance in any manufacture, and anything which promises to improve the quality of the product, to lessen the labor and cost of preparation, or to lead to the utilization of a hitherto waste product, deserves at least a careful hearing. One of these possibilities seems to be foreshadowed in the wool manufacture.

As is well known, wool, as it is cut from the unwashed sheep, yields from 40 to 75 per cent. of extraneous matter. All this is waste product, and is washed away down our streams to their great damage. Of this large waste, from 12 to 40 per cent. according to the kind of wool, is a grease or oil with valuable properties, and the remainder is largely made up of nitrogenous matters, potash, and phosphates, in a very suitable condition to be returned to the soil from whence they were primarily derived. Of course, some wools contain sand and mineral dust to the amount of 10 or 20 per cent.

The total amount of washed and unwashed wool used in this country has been estimated at 250,000,000 pounds per year. This will yield approximately 112,000,000 or 115,000,000 pounds of scoured wool, or 45 per cent.; 45,000,000 pounds of grease (18 per cent.); 30,000,000 pounds of fertilizer (12 per cent.).

The recovery of a portion of the valuable material has been attempted in France in two ways:

First, by the treatment of the wash water for the recovery of the grease in a form for gas manufacture, or for the recovery of the potash by the incineration of the evaporated residue, which yields also a very finely divided charcoal, used instead of lampblack; prussiate of potash has also been manufactured from these residues. By this method, which is an inconvenient one, requiring large tanks and numerous operations, only a portion—about one-third—of the total greasy matter is saved; and none of the nitrogenous matter.

The second method used was the extraction of the grease by means of bisulphide of carbon. The dried wool was then sent to the picking and beating machines before washing, and the wool dust thus obtained was sold for fertilizing purposes. The danger in this process is two-fold—the yellowing of the wool by the bisulphide of carbon, and the heat necessary to volatilize the last traces of the solvent (150° to 170° F.)

This method, theoretically good, has never been practicable in this country by reason of the cost of bisulphide of carbon. But we have a solvent for grease, in many respects superior to this, which has never yet been applied in this country on a large scale for this purpose, and we have no evidence that, before the present year, any accurate experiments have been made with the best form of this solvent. We have been told of several patent processes for the use of "benzine" for the extraction of the grease, but from the statements as to the results, as well as from a knowledge of the articles sold under the name of "benzine" a few years since, we have no hesitation in saying that the material used was not of proper quality for the purpose, or was not carefully applied.

A certain amount of moisture seems necessary to the suppleness of the wool, and any degree of dry heat which takes away this needful moisture renders the wool brittle and harsh. This drying of the fiber is probably the cause of injury in the processes hitherto used.

Our experiments have been made with a quality of naphtha called "gasoline," of about 86°. We have packed the wool in a closed vessel, and allowed the naphtha to remain in contact with it for about twenty minutes, without any application of heat. The liquid was then drawn off and fresh naphtha run in; the process being repeated two or three times, according to the amount of the grease in the wool. "Gasoline" of this quality boils at 90° to 100° F., and air of 50° or 60° F. completely removes it. The naphtha has no affinity for water, and does not, in this cold liquid form, carry away any moisture; very little will be taken out by air at 60° F. before the naphtha is all gone.

In the large way a current of warm air would now be passed through to carry off the absorbed liquid; in our experiments we simply exposed the drained wool to the outdoor air for a few hours. The wool is picked and beaten (the dust being saved), then put into warm water and washed without the aid of any other substance than the soap of potash which is left on the fiber, untouched by the naphtha.

The wool thus obtained is very white and soft, and has a "crinkly" appearance.

The objections which have been made to a process of this kind, whether benzine, fusel oil, or bisulphide of carbon is used, are:

1. That the grease is too completely removed, part being needed to work the fiber.

2. That the grease is also removed from the inner tube of the fiber.

3. That the potash is left in a caustic condition, and hence certain to injure the wool.

In regard to the first objection, Grothe,* the great German authority, says that the office of the natural grease is so distinct from that of the oil added to facilitate manufacture, that this cannot be held valid. The natural grease envelops the fiber as it comes from the hair sac in the skin, making a somewhat stiff coating over it, and only after the removal of this is the wool in the best condition for completely good carding, and also for fulling.

The second objection, that the grease is removed from the tube of the fiber, seems to be founded on earlier ideas. Grothe does not mention this as an objection, and, in the description of the hair,† says: "In the axis of the hair-shaft is found the pith. This pith is not evident in all wools. In some sorts, viz., Vicuna, it is much developed. The pith-cells contain either liquid or air."

Kölliker‡ says that the pith is wanting in colored head-hairs and in most wools: "On treating white hair with caustic soda we get the pith-cells, which do not contain, as was formerly supposed, fat or pigment, but air bubbles."

It has been stated that washed wool, after a time, becomes greasy, and it has been supposed that the additional grease came from the pith of the fiber. It is suggested that, as

* Grothe, Wolle, vol. i., p. 70. Berlin, 1878.

† Grothe, Wolle, vol. i., p. 18.

‡ Kölliker, Gewebelehre.

soap can never be entirely washed out of any material, this grease may be derived from the soap used in washing, which is partially decomposed by the cold rinsing water.

The third objection, that the naphtha or other solvent takes the grease away from the potash on the wool, and thus allows the latter to attack the fiber, seems also derived from a former idea of the nature of the substances under consideration—an idea which is not correct, but which still prevails. The following quotation, from an address made in 1872 to a wool manufacturers' association, seems to give the prevalent opinion: "In its natural state, as taken from the sheep's back, the whole fleece is filled with a yellowish matter called by novices grease, but known among dealers as yolk. It is not grease, but a partial soap, being largely composed of alkali, and becoming, if suffered to lie until the volatile oil has dried out, almost a pure soap of itself; hence, as all manufacturers know, old wool scours by ordinary processes much easier than new wool just shorn."

Hartmann, in 1868, showed that the "yolk" is a true grease, containing cholesterin in place of glycerine.*

Schultze,† of Zurich, in 1873 and 1874, carried on the research on certain kinds of wool, and it is to his investigation and that of his associates that we owe nearly all our present knowledge of the composition of the "Wollfett," or grease. He has not only proved the presence of cholesterin but of iso-cholesterin and other analogous alcohol. We now know that these substances are in the place of glycerine; hence the far more difficult saponification of this grease than of lard and tallow, which are compounds of glycerine with the fatty acids. Also, the indications are that the wool-fat in the different races of sheep is composed of varying quantities of these cholesterins.

The presence of cholesterin in wool-fat is a very curious fact. Hitherto cholesterin proper has been known chiefly as a product of excretion from the brain, eliminated by the liver; hence its presence in bile. Gautier‡ says: "Cholesterin is to the brain what urea is to the blood and other organs."

Why we should find this same substance on the wool of sheep is an unexplained mystery.

The grease is dissolved out by naphtha in the same condition as it is in the wool; a potash soap remains behind untouched.

The proof that the potash is not left caustic is that the concentrated wash water shows but a very faint alkaline reaction; only on subjecting it to a high temperature does the reaction become strongly alkaline, showing that a decomposition has taken place.

It may be supposed that because carbonate of potash is made from wool washings, therefore it exists as such in the wool. It is also obtained from wood ashes, but in neither case does it exist as carbonate before incineration.

The advantages claimed for the naphtha process are the more perfect cleansing of the wool, the better condition of the fiber for taking dyes, etc., the ready recovery of the waste products, hence a prevention of further pollution of streams from wool-washing establishments.

The disadvantage allowed is the inflammable character of the naphtha, rendering a separate building necessary. This is not an insurmountable obstacle, as the use of the substance for several industries has been perfectly successful.

The ultimate cost of the process will depend largely upon the value of the recovered products. This subject has as yet only been touched upon, but we have ascertained that the recovered oil is "equal to the best" for currying leather. It is not liable to spontaneous combustion.

The accompanying tables will show the great variation in the wools already tested, the small amount of potash to be obtained, and the necessity of a large number of tests.

WOOLS.	Weight taken in grammes.	Per cent. taken out by naphtha.	Per cent. lost on picking.	Per cent. lost on washing in warm water.	Total per cent. lost in cleaning.	Yield of clean wool, per cent.	Carbonate of potash in crude wool.	Per cent of organic matter. Dust picking.	Ash of the grease in per cent. of the grease.	Composition of the residue from evaporating the wash water.				
										Per cent of carbonate of potash.	Iron oxide and phosphate of lime.	Lime carbonate and magnesium carbonate.	Sand, etc.	Total volatile organic matter.
No. 1 Victoria. Not liable to moths	70	21·43	2	21·57	45	55	3·3	.....	0·38	15·4	3·6	Very little calcium, trace of magnesium.	25·8	55·2
No 2. Cape of Good Hope, Natal. Full of moths	70	21·70	22	15·1	58·8	41·2	1·1	41·45	1·72	7·3	2·7	Like No. 1.	35·3	54·7
No. 3. Buenos Ayres. Full of moths	70	13·57	15·3	36·13	65	35	3·1	.....	3·5	10·7	1·5	0·6	34·8	52·4
No. 4. Adelaide. Many moths	70	22·86	18	19·14	60	40	1·4	18	5	7·6	4·3	1·6	40·4	46·1
No. 5. Victoria. Not much injured by moths	70	18·57	6·7	24·63	49·9	50·1	3	.....	1·4	11·7	1·3	0·5	39	47·5
No. 6. Cape of Good Hope. Liable to moths	70	13·57	4·5	38·33	56·4	43·6	4·4	.....	3·8	11·5	3·3	0·8	36·3	48·1
No. 7. Uruguay. Many moths	70	12·87	8	39·43	60·3	39·7	2·5	....	3·2	6·5	0·9	0·5 magnesium. Trace only.	46·7	45·9
Vermont wool. Very greasy.	71	38·5	....	.....	76·7	23·3	.....	.....	.....	.....	.....	.....	.....	.....
West Virginia Wool. Very fine	1,088	.....	....	21·6	....	....	4·2	.....	....	19·5	.....	.....	.. ..	....
Mixed wool	33,770	25	....	.....	....	....	....	.....	0·8	.....	.....	.....	....	....
" "	7,400	.....	....	9	....	....	2·5	.....	....	2·73	.....	.....	....	....

Naphtha dissolved the grease of all but Nos. 9 and 10 with the greatest facility. These two samples seemed to be older wool, and to have free cholesterin, which was more difficult of solution.

All the samples of wool noticed in the table, except No. 10, were kindly furnished by Mr. George Wm. Bond, to whom we are under great obligation for his interest and co-operation.

No. 10 was furnished by the agent of the Washington Mills.

The table will show the small amount of potash which can be obtained, reckoned as percentage, on the raw wool. We were surprised at this result, as we had been led to suppose from various statements that there was a larger per cent.

The small quantity of ash left by incinerating the grease shows also that it is not a soap of either lime or potash; a portion of this ash was carbon, which is very difficult to burn entirely when derived from cholesterin. It must be remembered, also, that this was crude grease, which doubtless mechanically carried down some of the other substances.

ELLEN H. S. RICHARDS.

Massachusetts Institute of Technology,
Boston, May 5, 1879.

We may also cite, in confirmation of these laboratory experiments, the commercial success of the Adamson process of extracting oil by means of naphtha from bone, dead meat, and even in paying quantities from the meat scraps previously treated in the most powerful presses.

This process is also now being applied commercially to linseed and cotton seed, and, in witness of the great affinity of naphtha for oily matter, it may be stated that Mrs. Richards has lately treated some of the hardest and driest cotton seed cake from the most powerful steam press now in use for the extraction of the oil; and we find that, after the utmost quantity of oil had been removed by the press, there still remained a quantity equal to fifteen and seventy-seven hundredths per cent. of the weight of the cake.

While the direct result of our investigation of wool oil has therefore only given us the data by which to cause one or two mixtures to be avoided, that apparently contained volatile mineral oil, we may yet hope that the final result may be a substantial improvement in the method of scouring wool and woolen fabrics, and the saving of a waste substance of great value not only to the woolen manufacturer, but also to the leather dresser, for whose use large quantities of "de gras" are now imported of a much less pure quality than can be obtained by the naphtha process.

Since naphtha itself is almost a waste product in this country, and is somewhat difficult to obtain in large quantities abroad, owing to the cost and danger attending its transportation, its application to the treatment of wool can be made in this country at much less cost than elsewhere.

The cost of the apparatus would be small, and the waste of material very little, as it can be saved by condensation, with very little loss in each treatment.

We should not now urge this method so strenuously upon the attention of members, were it not for the absolute conflict of testimony and utter want of uniformity in the present practice.

There may be, of course, difficulties in the application of this treatment in large practice that do not appear in laboratory experiments. We submit this evidence only for what it is worth, and as affecting a matter of great practical importance.

Any member who desires further information, or who wishes to see samples of wool thus treated, and of the oils and emulsions obtained, may apply to Mrs. Richards, at the Women's Laboratory of the Massachusetts Institute of Technology.

BRIEF REVIEW OF THE MOST IMPORTANT CHANGES IN THE INDUSTRIAL APPLICATIONS OF CHEMISTRY WITHIN THE LAST FEW YEARS.*

MATERIALS AND PROCESSES CONNECTED WITH CLOTHING.

General Chemical Treatment of Textile Materials.—The old fashioned method of washing wool, involving entire waste of the large amount of potassium soaps of fatty acids, fatty alcohols, and their compound ethers, which constitute the grease to be removed, has been improved on, to some extent, by extraction of the fatty matter with carbon disulphide or petroleum naphtha, but yet more by the Maumené and Rogelet process for making potash, by regulated leaching of the wool, evaporation of the liquid obtained, and either at once burning off organic matter, or charring in close vessels, with utilization for illuminating purposes of the gaseous products given off.

The practice has become established of freeing wool from burs, bits of straw, or other forms of vegetable fiber, by soaking with dilute sulphuric acid, pressing out surplus liquid, and gradually heating the wool up to about 100° C., the vegetable impurities being thus so attacked that they are readily reduced to dust and mechanically removed. Solution of aluminum chloride has been used for the same purpose, as also gaseous hydrochloric acid, and mixed fabrics of wool and cotton or linen may be broken up and the wool recovered in useful form.

The advantage of using *hard* water, containing lime salts, in reeling raw silk has lately been pointed out, the amount of gelatinous matter removed in solution from the surface of the fiber being thus diminished, and loss of tenacity and of beauty in appearance lessened.

Attention has been prominently drawn of late to the extending habit on the part of too many manufacturers of fraudulently "weighting" textile fabrics with foreign substances, introduced to give apparent density to flimsy products of the loom. Cotton and silk have been the materials chiefly treated by such objectionable methods. The sizing legitimately used upon the warp of cotton goods, to give strength and smoothness of surface to the threads in weaving, consists mainly of flour with the gluten partially altered by fermentation, with soap and fatty matter, and should not much exceed five per cent. of the weight of the finished cloth; but white porcelain clay in large quantity, magnesium chloride to attract and retain moisture, and a little zinc chloride producing the same effect and also acting as an antiseptic to obviate mildew, have been extensively employed of late years, sometimes forming altogether fifty or even sixty-five per cent. of the cloth as sold. It is reported also that magnesium sulphate from Stassfurt kieserite has been largely applied to this use, the cloth being passed through a concentrated solution of the salt and then gradually dried.

Silk goods are also notoriously "weighted" to an enormous extent, chiefly in the course of nominal dyeing, both organic and mineral materials being used, among the latter salts of lead, barium, aluminum, etc., with viscid material, such as shellac dissolved in a watery solution of borax, to produce attachment to the cloth, and hygroscopic substances to attract moisture, often with serious injury to the durability of the real fabric, which is more or less corroded and weakened. Samples are reported in which the foreign substances introduced have amounted to two-thirds of the whole weight.

Bleaching, including the Manufacture of Chloride of Lime.—Compulsory condensation of the hydrochloric acid produced in the alkali manufacture by Leblanc's process has for some years tended to fix, even more than formerly, as a regular concomitant of this industry, the production of bleaching powder.

The most important event in the history of the latter has been the really successful solution of the problem of regenerating the manganese employed in such form as to be used over again. The process first introduced for this purpose by Dunlop, although capable of being worked, has never found general acceptance, while that of Weldon has within ten years come to be very extensively, it may almost be said universally employed, and with highly satisfactory results, the loss of manganese being now reduced in well managed works to one and a half per cent., while the production of bleaching powder has within the same time increased threefold, and its price has been reduced by one-half. The process itself, consisting in precipitation of the still liquor, containing manganous chloride, by an excess of calcium hydrate, and oxidation of the precipitate by air forcibly blown for some time through it and the liquid in which it is suspended, has been gradually improved, so that now the chief product seems to be an acid calcium manganite corresponding nearly to the formula

$$\left.\begin{matrix}Ca\\H_2\end{matrix}\right\}(MnO_2)_3.$$

It still yields, however, large quantities of calcium chloride as a by-product, and a satisfactory mode of utilizing the chlorine thus carried off remains, as has already been noted in this report, an important desideratum. The Deacon process for making chlorine at the expense of the oxygen of the air, avoiding altogether the use of manganese, is still in use to a small extent, but has been found to involve a good deal of difficulty, especially in maintaining in a state of activity the sulphate of copper used as the means of promoting the action of atmospheric oxygen.

The conditions for the production of the best chloride of lime have become better understood, particularly the advantageous use of a considerable excess of lime, and a low temperature during the absorption of the chlorine, and the avoidance of packing the product while in too fresh and moist a state.

In the bleaching process itself there is no capital novelty to record as to the use of chlorine, but it is interesting to note the actual introduction upon an industrial, though still limited, scale of the use of hydrogen dioxide, said to be now applied with special advantage to the treatment of Indian tusseh silk. Potassium or sodium permanganate, followed by a weak acid, was also for some time used as a bleaching agent, but has been practically discarded. Atmospheric oxygen in presence of oil of turpentine has been applied to the bleaching of feathers and some other materials of animal origin. One of the most useful of modern improvements, when properly managed, seems to be the combination of chlorine and air bleaching; linen goods in particular, and some of the higher grades of cotton cloth, being satisfactorily bleached by preliminary removal of most of the color with the aid of chlorine, and completion of the process after the ancient fashion of exposure to sun and air, so as to combine the rapidity of the one method with the exemption from injury to the fabric of the other.

Preparation of Dyestuffs.—In the history of these materials five principal phases are observable. First, in the earliest times, the use of native dyes of organic origin, chiefly derived from the vegetable kingdom. Secondly, since the discovery of America and the early voyages of the fifteenth and sixteenth centuries to the west coast of Africa and to India, the use of exotic dyes, also organic. Thirdly, since the middle part of the last century, the employment of mineral dyestuffs, such as iron buff, chrome yellow, etc. Fourthly, within the last twenty years, the introduction of artificial organic colors in vast number and variety; and lastly, within but about ten years, the successful reproduction of natural organic colors by artificial means.

The changes in regard to the preparation of natural dyestuffs have not of late been very numerous or important. A marked falling off in the production of madder, and of the various partially purified or concentrated forms in which it comes to market, such as garancine, has been the consequence of the introduction of artificial alizarine. Ammonia, instead of lime, has been applied with advantage to the extraction of indigo in Java, and in India it has been found that by using steep water heated to 110° F. by steam, instead of water at the natural temperature of 92°–95°, an increase of product may be obtained amounting to as much as 25 per cent., the exhaustion of the plant being so complete that further steeping gives practically no more color. For sundry of the long known vegetable dyes the use of concentrated extracts prepared by exhaustion with water and evaporation to solid or pasty consistence, has to a considerable extent replaced the immediate employment of the crude wood, bark, or other vegetable material; the character of these extracts, both as to solubility and tinctorial power, has undergone no small improvement.

Our knowledge of the coloring principles of several important natural dyestuffs has been advanced, as in reference to hæmatoxyline, bresiline, indigotine, and orcine; the syn

* Inaugural Dissertation. Göttingen, 1868.

† Journal für Praktische Chemie.

‡ "Chimie appliqué à la Physiologie," vol. ii., p. 214.

* From the *American Chemical Journal*.

thesis of the latter two has been accomplished, though not yet with industrial results,* and will probably be succeeded ere long by that of the others.

Artificial Coloring Matters.—It is, however, chiefly with artificial dyestuffs that the industrial, as well as scientific history of the last few years has been chiefly occupied. The whole of this brilliant chapter of the subject is so recent, and has attracted such general attention, that it is not easy to decide what may merit special mention as newest and most interesting.

The preliminary treatment of the coal tar, which forms the main material with which the maker of artificial organic colors works, has become systematized, and in many of its details improved. Particularly has the management of the later stages of coal tar distillation become better understood. Agitation of the contents of the still, distillation in a current of indifferent gas, and other modifications of practice have improved the yield of the less volatile products, especially the valuable anthracene, whose purification also is better provided for than formerly. The hydrocarbons of lower boiling points—benzene, toluene, etc.—are obtainable of much greater individual purity than some years ago, and in mixtures of more definite and uniform character adapted to the preparation of particular classes of colors. A satisfactory direction for the employment of much of the heavy coal tar naphtha remains still to be found. Looking to a supposed probability that the supply of coal tar may be cut short by the progress of electric illumination, Greiff has lately calculated that about 4,000,000 kilos of crude benzene are needed per annum for the production of aniline colors, and 900,000 kilos of pure anthracene for making artificial alizarine, and claims that, even should coal gas altogether cease to be made, coal might nevertheless be profitably distilled (with modification of the process) for its other valuable constituents, especially those just named, and that these (benzene, toluene, and anthracene) can also be readily obtained, and in sufficient quantity, from the residues of distillation of petroleum of the Caucasus, raising the question also whether American petroleum residues have been adequately examined in this direction.

In regard to the original so-called aniline colors, one of the most important changes has been the application on the great scale of Coupier's process, or a modification of it, for making aniline red (rosaniline salts) without the use of arsenic. This process, consisting essentially in heating together in the presence of an acid nitro-benzene and commercial aniline oil of high boiling point, rich in toluidine, has been adopted by several of the largest manufacturers. The important researches of E. and O. Fischer, Rosenstiehl, and Dale, and Schorlemmer, have proved that under the name rosaniline have been included both isomeric and homologous bases of generally similar character, and Dale and Schorlemmer have shown that of these para-rosaniline, with the formula $C_{19}H_{17}N_3$ (identical with that made from para-toluidine) may be prepared from phenol by converting this into aurine, $C_{19}H_{14}O_3$, and heating the latter with an excess of aqueous ammonia; while if aurine be heated with aniline the final product is tri-phenyl-pararosaniline, thus establishing full connection between phenol and the whole series of aniline colors.

The original aniline violet of Hofmann, obtained by the methylation of preformed rosaniline salts, has been to a large extent replaced by the "*violet de Paris*," made by first heating aniline under pressure with methyl chloride, or methylic alcohol and hydrochloric acid, thus obtaining methylated aniline derivatives, and then oxidizing such product by heating it in the air, mixed with sand and a salt of one of the heavy metals, usually cupric nitrate, to facilitate the oxidation process. Monnet, Reverdin, and Noelting have lately shown that, of the mono and dimethyl anilines and various isomeric mono and dimethyl toluidines obtainable from commercial aniline oil in the first stage of this manufacture, pure dimethyl aniline is the only one which can be advantageously used in the preparation of the violet, in view of adequate yield, solubility, etc., of the product. The finest phenylated blues are now made by heating together very pure rosaniline (made by Coupier's process), a large excess of pure aniline, and benzoic or stearic acid, preferably the former. Aniline green, "*vert lumière*," is now made by heating methyl salts with methyl aniline violet, thus dispensing with the costly use of iodine. But methyl green has itself been largely replaced of late by "malachite green," made by the action of benzoyl trichloride on dimethyl aniline; the color so obtained exhibiting superior stability in comparison with the methyl and iodine greens. The soluble aniline blacks—"indulines" and "nigrosines"—have come into use for general dyeing purposes, particularly in some forms specially fit for use upon silk goods. The indulines appear to be phenylated derivatives of violaniline, while in the nigrosines phenyl has been substituted for hydrogen in the phenyl groups of the same base. The sulphonates of both are soluble in water as well as alcohol. Almost pure aniline, it has been found, is necessary for the production of these black dyes of the best quality.

Diphenylamine has come to be largely made by heating together under pressure aniline and its hydrochlorate, and blue and green dyes of peculiar tints are manufactured from it. The hex-nitro-derivative, "aurantia," is also one of the more recently introduced dyes.

The phenol colors, picric acid, isopurpurate of potassium, and aurine, have shared in the advantage from increased purity of commercial phenol. It has been lately proposed to make picric acid by slowly adding the sulphacid of phenol to concentrated nitric acid, the reaction proceeding slowly, and without requiring application of heat. The formula of aurine (red coraline) has been established, and the conditions of its production from phenol studied.

The beautiful resorcine derivative, eosine, is of comparatively recent introduction, and has established its claim to be considered a valuable addition to the resources of the dyer. The phthaleins of phenol, resorcine, and other phenolic substances have of late been converted into eosine and analogous coloring materials by using, instead of bromine itself, a mixture of a bromide and bromate (or corresponding chlorine or iodine compounds) with acetic acid or some other weak acid; and alkaline hypochlorites have also been employed to thus modify the preparation of aureosine and other colors of the eosine class, whose beauty is unfortunately not equaled by their permanence. Methyl, benzyl and other alcoholic radicals have also been used to form substitution products of resorcine and the colors derivable from it. The triatomic phenol, pyrogallol, has given rise to the dyes "galleine" and "cœruleine."

The naphthalene colors have perhaps not established and extended themselves as largely as some other classes, but the calcium or sodium compound of dinitro-naphthol ("Martius' yellow") still retains its place among valuable dyes.

It is needless to say that artificial alizarine from anthracene has within ten years replaced to an immense extent the natural madder, and become recognized in the very front rank of artificial coloring materials. There have been important additions of late to our knowledge of the isomeric and closely related coloring substances occurring in artificial alizarine, and new nitro and amido-derivatives of alizarine, with tinctorial properties, have been obtained, and the isomerism of these bodies in a measure worked out by the researches of Perkin, Rosenstiehl, Schutzenberger, Morton, and others. Alizarine blue, a derivative of mononitro-alizarine, attracted for some time attention as affording the means of producing tints like those from indigo, but it proved unstable on exposure to light, and has disappeared from commerce. New red, violet, and blue colors have lately been obtained from mono and diamido and nitro anthraquinone, of which some may perhaps prove permanently useful.

Beautifully colored derivatives of phenanthrene have not long since been announced.

A large class of tinctorially valuable materials has quite recently been introduced, the so-called azo colors, produced by the reaction of di-azo compounds, upon phenols, amido compounds, etc. The comparatively long known and permanent "Bismarck brown" consists principally of tri-amido azobenzene. The prototype of the many recently introduced colors is "chrysoidine," the hydrochlorate of meta-diamido-azobenzene, and it has been followed by the production of the "tropæolines" and numerous other parallel derivatives of phenol, cresol, naphthol, resorcine, pyrogallol, etc., modified in various ways by the presence of hydroxyl, nitryl, amido, sulphonic, and other groups. These new dyes are chiefly of yellow, orange, and scarlet red tints.

Witt has lately described toluylene blue, violet, and pink, representatives of a new class of colors obtained from diamines by simultaneous oxidation of amido and methyl groups, and forming in a sense a connecting link between the rosaniline series and that of the azo colors.

The "Cachou de Laval" of Croissant and Bretonniere, although of undetermined and probably indefinite constitution, is a material of too much practical value to be passed over without notice. Made by heating to 250° or 300° C., in close vessels, various waste forms of vegetable fiber, such as sawdust, spent dyewoods, rags, paper refuse, and the like, with caustic alkali and sulphur, the product is obtainable of various colors, chiefly tints of brown, and is remarkable for the firmness with which it attaches itself to cotton cloth, particularly when fixed with bichromate of potash, while its modifying effect upon the brighter coal tar dyes is very satisfactory, and its cheapness constitutes an important advantage.

Ingenious attempts have been made by Witt, by Graebe, and Liebermann, and others to generalize our knowledge of organic colors, and to determine some definite relation between their composition and tinctorial power, but so far such attempts have had but very limited success.

Mordants.—Among the more recently introduced materials for fixing colors upon cloth may be named silicic acid, obtained by immersion of the cloth in solution of sodium silicate, followed by a dilute acid bath; chromic hydrate from otherwise waste chrome alum; and precipitated sulphur, thrown down by successively passing the cloth through solution of sodium thio-sulphate and hydrochloric acid, useful in fixing aniline green, eosine, etc. In attaching to cotton the aniline colors, extensive use is made of albumen, "lactarine," and tannic acid, the last named with or without the addition of an antimony salt (tartar emetic). Eosine has been to some extent fixed by means of lead acetate, and calcium phosphate has been employed for some of the aniline dyes.

Dyeing.—The modifications of long established practice in the actual processes of dyeing have been chiefly matters of detail growing out of the extensive introduction of the artificial organic colors, as, for example, the "animalization" of vegetable fiber, and the use of alcohol as a solvent in the dye vat. It has been proposed to modify the process of dyeing logwood black by using chrome alum (with iron alum and cream of tartar) instead of bichromate before immersion in the logwood bath. The hyposulphites (hydro-sulphites of Schutzenberger) have been successfully used for the reduction of indigotine to hydrindigotine in the indigo vat.

Calico Printing.—The two capital changes in this art have been the introduction, on a great scale, and with remarkable brilliancy and variety of effect, of the coal-tar colors, and the use of pigments, largely of mineral origin, such as chromic oxide, ultramarine, etc., attached to the cloth by the aid of albumen, in the so-called "surface printing." The field of application of both these methods includes the use of sundry colors not available in general dyeing on account of the difficulty of attaching them uniformly over large surfaces of cloth. Among the most important colors to which this remark applies, is the insoluble aniline black of Lightfoot. The exact constitution of this valuable color remains still uncertain, but the conditions for its development upon cloth by the oxidizing action of potassium chlorate, aided by the presence of a minute amount of a copper or vanadium salt, upon a salt of aniline, usually the hydrochlorate, have been carefully examined. It has been reported that cerous sulphate has been for some time successfully substituted for a vanadium compound in this process, the resulting color being found, it is said, even faster than that made with vanadium.

Tanning.—Probably no branch of industry of equal importance with this presents less of notable improvement in its modern history. Such improvement as there has been belongs more to the mechanical than the chemical side of the manufacture. Some few new tanning materials of exotic origin have been introduced, but none upon a large scale, save perhaps Chinese and Japanese galls, which from their price rather fall into dyers' than tanners' hands. The manufacture of tanners' extracts, as of hemlock bark, chestnut, oak bark, etc., has been improved, and the use of such materials extended. The substitution of comparatively pure forms of some of the solutions ued for the many crude materials formerly employed has made some progress—as, for example, sodium sulphide instead of "rhusma" (orpiment and lime), for liming preparatory to removal of hair and epidermis, and a weak solution of ammonium chloride or hydrochloric acid, instead of dog or fowl excrement for "bating" where lime has previously been applied and the surplus requires to be removed. None of the many "rapid processes" of ordinary bark tanning can be considered to give altogether satisfactory result: the saving of time is apparently always attended with deterioration of the quality of the leather, particularly as to its durability in use. It has been claimed of late by Böttinger that to *phlobaphene* is essentially due the action of the common oak bark in tanning. In regard to alum tanning, Knapp and v. Wagner have shown some reasons for supposing that the alum and common salt used do not, as is commonly assumed, decompose each other in aqueous solution; but the evidence seems conclusive, and even should the fact be as stated, it might be reversed in presence of the skin in alum tanning. It has been lately proposed to use a salt of iron, ferric sulphate, as a tanning material instead of alum, and still more recently chrome tanning has been advocated. A method of dyeing, and at the same time partially tanning, raw hide has been introduced in the United States, resulting in the production of a material something like hard vulcanized rubber, and susceptible of a high polish, available for the tips of boots and shoes, and doubtless for various portions of harness and military accouterments not requiring flexibility. The solutions in which the properly cleansed hide is immersed contain infusion of logwood, nut galls, cupric sulphate, vinegar, and a salt of iron.

India-rubber, Gutta Percha, etc.—These materials may be briefly noticed here in relation to the manufacture of waterproof clothing, although their applications are so numerous and varied that it is not easy to assign them any single place in a classification of chemical substances founded on their uses. Great extension of the manufactures based upon the substances has for years been going on, but most of the novelty of such manufactures has had reference to varied and chiefly mechanical details of application, not to general chemical treatment. The supply of crude caoutchouc has been greatly increased by systematic research for it in many countries and from different botanical sources. The quality of the best soft vulcanized rubber has been sensibly improved, as exhibited in the extremely thin and light waterproof garments made from it. A very important improvement has lately been proposed, but the result not yet fully tested by experience, consisting in the admixture with rubber before the vulcanizing process is applied, of ten per cent. or more of very finely subdivided vegetable fiber, the object being to confer a certain degree of porosity so that the objection to rubber clothing, shoes, etc., from the retention of perspiration may be obviated. Perhaps the most noteworthy direction of improvement in the preparation of vulcanized rubber has been that of the production of hard rubber of the higher grades, such as the imitation of ivory for billiard balls, piano keys, etc., by an intimate mixture of caoutchouc and calcined magnesia, strongly compressed and hard vulcanized.

Although of altogether different chemical character, the most recently introduced and on the whole most important substitute for hard rubber in many of its applications may be mentioned in connection with it, namely, "celluloid," the curious material produced by converting paper into pyroxyline, grinding the product along with camphor so as to secure very intimate mixture, pressing and moderately heating the resultant mass. The extraordinary toughness of this material, giving it a character intermediate between that of vulcanite and horn, the readiness with which its appearance may be modified by coloring matters so as to imitate various natural substances, such as ivory, tortoise shell, coral, etc., the high polish of which it is susceptible, and its inalterability by water and most other agents likely to be brought in contact with it in common use, have already secured for it extensive employment for a multitude of different purposes.

J. W. MALLET.

* It has been very recently reported that Baeyer has succeeded in producing artificial indigo by a commercially practicable process, the starting point of which is benzene.

SCIENTIFIC NOTES.

MAIZE MEAL.

WE have repeatedly urged that this material can be advantageously used under the new act. It becomes entirely a question of price, and when we hear that maize meal is being offered at less than £7 per ton, while barley malt is worth over £15 per ton, it will be strange if this material is not soon used in our breweries. By proper treatment, maize meal may be made to yield an extract equal in gravity, and but little inferior in quality, to that derived from the best malt; and this may be effected without the aid of either acids or chemicals. When Payen and Persoz discovered the soluble ferment which they called diastase, they estimated that malt contained about 0·063 per cent. of this agent, and as one part of diastase is sufficient for the conversion of 2,000 parts of starch, it follows that one pound of malt is capable of converting about six pounds of starch into sugar. The experience of distillers who use large quantities of raw grain in combination with malt fully supports this view. The two important points to bear in mind are, that diastase, being soluble, is extracted at very low temperatures, and that starch must be converted into paste before the diastase will exert its solvent action on it. There is no reason why brewers should not contrive a system of mashing which will admit of maize meal being partially substituted for malt; but the greatest care must be taken to select only such samples as have been properly decorticated.

THE DIASTASIC POWER OF BARLEY.

It is a very common error to suppose that diastase is a constituent peculiar to malted grain; the soluble ferment which has such an extraordinary saccharifying action on starch is also present in barley and many other cereals, and this can be easily proved by making a mash with raw grain alone, when a very appreciable extract will be obtained. Some experiments quoted by Dr. Graham in his "Data for Brewers" make this question very clear; various mixtures of malt and barley were digested with ten parts of water at 140° F. for two hours; a mixture, half barley and half malt, yielded 59·8 per cent. of glucose and dextrine; four parts of barley to one of malt gave 57·92 per cent.; nine parts of barley to one of malt gave 53·20 per cent., and barley alone yielded as much as 44·20 per cent. of glucose and dextrine. These experiments conclusively prove that barley possesses, even before germination, considerable diastasic power, but it is doubtful whether the extract thus obtained from barley is suitable for making a sound and well-flavored beer.

USE OF FEHLING'S SOLUTION.

Those accustomed to use Fehling's solution for testing sugar solutions and beer worts often experience a difficulty in recognizing the exact point when the reaction terminates. With colorless solutions of sugar, the disappearance of the dark blue color of the Fehling's solution is a sufficiently exact sign, but if there should be any doubt, a little of the liquid may be filtered and acidified with acetic acid, and then the slightest trace of copper can be detected by adding a solution of ferrocyanide of potassium, which will produce a reddish-brown color, if any be present. But in highly-colored fluids, such as beer-wort, this indication with ferrocyanide is difficult to recognize, and, therefore, the fol-

lowing device is adopted: The filtrate is boiled with a few drops of the sugar solution in a beaker, allowed to settle, and then poured off; on wiping the bottom and sides of the beaker with a piece of white filter paper, it will be colored red if any copper was still left in solution.

THE REDUCING POWERS OF DIFFERENT KINDS OF SUGAR.

The action and method of using Fehling's solution have often been described in these columns; it is well known that pure grape sugar reduces the copper most powerfully, and that other descriptions of sugar do so in varying degrees. Taking the reducing power of grape sugar to be 100, Soxhlet has found the reducing powers of other sugars to be as follows:

Grape sugar	100
Invert sugar	96·2
Lævulose	92·4
Milk sugar	70·3
Galactose	93·2
Inverted milk sugar	96·2
Maltose	81

—*Brewers' Guardian.*

ASSEMBLY OF GERMAN NATURAL SCIENTISTS, 1880.

THE special sessions of the 53d Assembly of Natural Scientists opened on the 20th of September last at Dantzic, and were, especially in regard to chemistry, highly interesting.

The first lecture in the chemical section was that of Dr. Emmerling Kiel, regarding acetol and grape sugar. The author, in connection with Dr. Richard Wagner, has (as has been published in *Liebig's Annalen*) made special studies in order to produce a so-called acetol, the hydroxyl compound of aceton, and he obtained it by treating monobromaceton with oxide of silver and water, or better, by treating it with carbonate of potassium, for in this latter manner a great number of disadvantageous accidental products can be avoided. Acetol itself reduces alkaline oxide of copper in the cold, as only a few bodies are able to do; one part of the former reducing two parts of the latter. This property is already possessed by a very small solution of this body. The production of this product free from water has not yet been accomplished. All means hitherto employed, such as calcium chloride, dry sulphate of copper, potash, destroy it; fractionate distillation proves just as useless as the method of refrigeration. By combination of both methods, a solution was finally obtained which contained hardly 11 per cent. of acetol. This solution tastes sweetish, like walnuts, has about the same boiling point as water, and reduces copper, silver, and bismuth. In oxidizing it by means of chromate of potassium, acetic acid and carbonic acid are obtained according to the formula:

$$CH_3COCH_2OH + O_3 = CH_3COOH + CO_2 + H_2O.$$

By treating grape sugar with a solution of caustic potassium, the lecturer obtained a distillate which showed similar reductive properties, although in a lesser degree. In changing this experiment (in connection with Dr. Loges) so that into the molten grape sugar which was free from water a piece of potash was introduced, he obtained a distillate which seemingly consisted of a compound of two different bodies. The one having a boiling point of from 91 to 95° has not yet been examined, the other one, a liquid, seems to be remarkably similar to the above-described acetol as far as regards its reductive quality as well as its products of decomposition; the latter seem only to differ in so far as every mol. CO_2 seems to form 2 mol. of acetic acid, wherefore it is probable that each mol. of the new compound contained 5 at C. It seems to follow that the new body is a keton alcohol, which possesses great reductive qualities like benzoyl-carbinol and acetol.

Prof. Dr. Scheibler, Berlin, gave a lecture on *Saccharine*. The different kinds of sugar may be divided into those which are not changed by acids, and those which are not changed by alkalies. Grape sugar is transformed by acids into glycosis, which is again divided into two different kinds, dextrosis and lævulosis, while the latter, if treated with alkalies, branch out into a great many derived products; thus a mixture of dextrosis and lævulosis boiled with lime milk, becomes reddish brown, secreting a mixture of chamois-yellow salts of lime, the acids of which are as yet little known; one of them may be extracted by means of ether. The lime in solution, after filtration, is removed by applying oxalic acid; the liquid is condensed to the thickness of sirup and finally crystallized. Thus a body of the formula of the cane sugar is obtained. The rhombic crystals of this body have the same melting point as cane sugar (160–161°), and are characterized by the fact that they may be volatilized by heating them. This property has not yet been discovered in other kinds of sugar. The polarizing qualities of saccharine, although the latter consists of a mixture of dextrosis and lævulosis, turn the ray only toward the right, and much more energetically than the cane sugar. The number for the yellow ray, as regards the latter, is +67·2, while for saccharine it is +93 5. The lecturer has also produced the acathyl compound. This is a tough, thick liquid, which may be submitted to unfractioned distillation. Similar to saccharine, as regards crystallization, are a compound discovered by Berthelot called trihalosis, which has the polarization number +199, and the formula $C_{12}H_{24}O_{12}$, and the arabinosis obtained from gum arabic, or, as the lecturer has shown, from beets, turning the ray to +121, and having the formula $C_{12}H_{24}O_{12}$. It is a remarkable fact that a prismatic angle of saccharine, arabinosis, and trihalosis is 111° and several minutes. Prof. Böttger, Frankfurt a-M., read a short note on a liquid for platina plating. He said the best method was to bring as much of ammoniate of platina as possible into solution, and this is done best by using citrate of soda. Two small Bunsen elements are sufficient for the electrolytic decomposition. Prof. Dr. Blochmann, Konigsberg, lectured on the subject: "*Why does the gas mixture of the Bunsen burner burn with a luminous flame after it has been heated?*" If we introduce into the upper opening of a Bunsen burner a platina tube, which we can easily obtain by rolling together a piece of thin platina sheet, and if we heat this tube to a glow heat by a second burner, the flame which was not luminous before then becomes luminous. It burns with nearly the same intensity as pure unmixed coal gas. This fact has hitherto been explained in the following manner:

The luminous light may be taken by decolorization from luminous flames (for example, by adding to them inert gases as N, CO_2, H_2O, etc.); and, *vice versa*, by adding heat the flame can again be made luminous. It has now been stated that on account of the same fact, the gas mixture of the Bunsen burner becomes luminous, and that it is simply the consequence of an elevation of the temperature to which the gases are subjected, by passing the glowing platina tube.

This explanation to Dr. Blochmann seemed insufficient. He believed it was necessary, first, to ascertain whether the chemical composition of the mixture of air and coal gas becomes changed if brought into connection with the glowing platina tube. This could only be done by analysis. He therefore collected a gas mixture of the Bunsen burner before and after it had passed through the glowing platina coil and analyzed it. The mixture, before it was heated, consisted of 60 per cent. of air and 40 per cent. of coal gas; after it had passed through the heated tube most of the hydrogen and all of the oxygen had disappeared, the swamp gas and the heavy carbureted hydrogens of the coal gas had decreased only a little, and carbon oxide had increased. In the combustion products 22·2 volumes of water vapor and 1·4 volume of carbonic acid was discovered. This combustion was also verified by another experiment. The platina tube (10 cm. × 8 cm. = 80 c. c. = 4 g.) which had been used in the previous experiments, after it had been coiled together in a spiral form, was introduced into a hard glass tube having the width of a Bunsen burner. Even in clear daylight, after the burner was removed, the spiral became luminous, water collected in perceivable drops in the cold part of the tube. The gas mixture, which is led over the heated platina, contains only 20 per cent. of combustible substances; the rest consists of about 55 per cent. nitrogen, and 25 per cent. combustion products. The flame is not luminous, appears lacerated, and, as may be seen, belongs to the category of the flames which have been deluminated by means of inert gases.

It was not possible to make the flame luminous by means of exterior heat, the attenuation being too great. Just as little was it possible to produce a luminous flame by introducing into a gasometer a mixture of air and coal gas, and leading it through a Bunsen burner the air openings of which were closed, even though the platina tube which formed the point of the burner was heated to the highest temperature. These experiments prove that the *elevated temperature* to which the gases are subjected in passing the platina tube *is not* the reason of the luminosity.

The lecturer now explained in what manner the air enters into the Bunsen burner, and the effect which the heating of the burner tube must have upon the gases in its interior. By this effect, according to the greater or lesser heat, the entering of the air through the air openings of the burner is either perfectly or partially prevented. The original proportion of air and coal gas in the tube is thus changed, and this is the reason of the luminosity.

OZONE IN THE AIR.

FOR many years the question concerning the occurrence of ozone in the air has been regarded as satisfactorily answered, and little doubt has been expressed regarding its presence. The influence exerted by ozone upon those who breathe it has been discussed very fully; efforts have been made to secure regular systematic observations on the amount of ozone present in the air, and it is safe to say that millions of such observations have been made and many of them recorded. It is hence somewhat startling to find that one of the most careful chemical investigators, one who has acquired an enviable reputation by his painstaking investigations on hydrogen peroxide, E. Schöne, should at this late day seriously question the proofs which have hitherto been adduced for the purpose of demonstrating the presence of ozone in the air. Indeed he feels warranted in stating that "*as yet we possess no chemical reaction by means of which we can prove the existence of ozone in the air.*" The proofs which have been brought forward are mainly those of Schönbein.

Schönbein bases his belief upon three reactions: 1. Something in the air sets iodine free from potassium iodide and caustic potassa is formed. 2. Papers saturated with a solution of manganese sulphate are turned brown in consequence of the formation of Mn_2O_3. 3. Thallium suboxide is oxidized to thallium oxide. But Schöne's investigations have shown that these changes of potassium iodide and thallium suboxide can be effected as readily by hydrogen peroxide as by ozone, and hence the reactions by no means prove the presence of ozone in the air. So also the change of manganese sulphate does not require the presence of ozone, as it is effected by air free from ozone, in which a trace of ammonium carbonate is present; and as this latter substance is normally present in the air, the proof based upon the change of the manganese sulphate papers loses its value. The proofs brought forward by Houzeau, and later by Andrews, are based indirectly upon the supposed absence of hydrogen peroxide, but since this substance has been shown to be present in the air the proofs are worthless.

The only known reagent by means of which the existence of atmospheric ozone could be positively proved is metallic silver. But no one of the observers mentioned above has ever noticed a blackening of silver in normal air free from sulphur compounds, and Schöne himself has been unable to detect more than the slightest change in color of silver foil exposed for long periods to the action of the air.

As regards the supposed formation of ozone during thunder storms, the odor of the air noticeable under these circumstances is not, as Schöne states, that of ozone, and further it is difficult to see how ozone could be formed by lightning, as the electric *spark* in a mixture of oxygen and nitrogen causes the formation of only hyponitric acid, while the silent discharge is necessary for the formation of ozone. Schöne does not deny that ozone may be present in the air, but simply shows that at present we possess no valid proof of its presence.—*Ber. d. deutsch. chem. Gesell.* 13, 1503.—*Amer. Chem. Jour.*

APPARATUS FOR THE MANUFACTURE OF GAS BY A COLD PROCESS.

By HECKEL and O. OTTMANN, of Neustadt a. d. H., Po. G. E. 8,865.

THE apparatus for this process consists of four parts, and produces a gas which burns without smoke, and gives a light which is equal to that of from twenty to twenty-four candles. The single parts of the apparatus consist of a mixing tub, a generator, a gasometer, and a carbureter. The first two vessels have a cylindrical form, and are made of lead. For the sake of security they are surrounded by wooden cases, which are held together by hoops. A quantity of iron scraps are brought into the generator, while the mixing tub, which is placed above it and connected with it by a lead pipe, which can be closed by means of a tap, is filled with diluted sulphuric acid. This acid is conducted into the generator, where hydrogen is developed, which at once enters into the gasometer. This latter is constructed either from wood and iron or from bricks and iron. From the gasometer a pipe leads to the carbureter, which consists of sheet iron plated with lead, and which has at the top a funnel provided with a tap. A small quantity of gasoline is poured through this funnel, and the tap is closed. By this process the hydrogen is carbureted by means of the carbureted hydrogen, and the gas thus receives its lighting power. Eight ordinary gas burners consume within an hour 1·3 cubic yards of the gas, which costs about six cents—*i. e.*, per burner per hour ¾ of a cent. This apparatus can be very advantageously used by proprietors of isolated country houses, of hotels, of manufactories, etc.

A NEW OPTICAL MILK-TESTING APPARATUS.

THE different methods hitherto employed for the testing of milk are still very imperfect. The chemical analysis cannot be executed by a non-scientific person, and is otherwise too expensive and takes too much time, while the areometer test gives no exact results.

A much more reliable one, is the optical method of testing, and upon this method is based the construction of a new apparatus which was invented by Mittelstrass Bros., of Magdeburg, which is considered by authorities to be excellent.

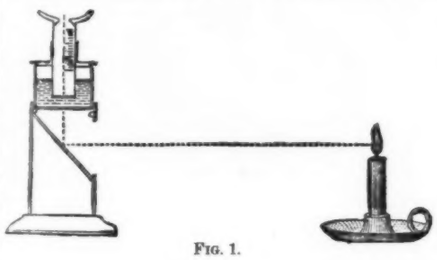


FIG. 1.

The apparatus, which is indicated in Fig. 1, consists of a tin cylinder which is blackened inside and contains a mirror inclined 45°, opposite to which is an oval opening. Upon this cylinder there rests another cylindrical vessel with a glass bottom and brass walls, which serves to hold the milk. This vessel can be tightly closed by means of a cover which is perforated and which contains a tube that can be moved up and down. This tube is furnished with a scale on one side and is also closed with a glass bottom so that no milk can enter it.

When milk is to be tested a burning candle is placed about 30 inches from the apparatus opposite to its opening, and the flame of this candle will be reflected in the mirror.

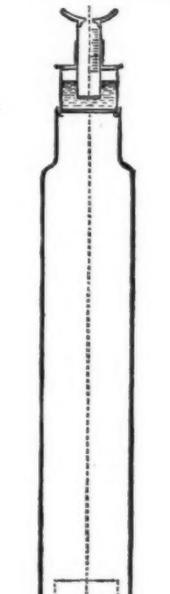


FIG. 2.

Now, after a small quantity of milk, which is diluted in a certain proportion, has been poured into the cylindrical vessel, the observer looks through the tube horizontally down upon the reflected picture of the flame, and adjusts this tube by moving it upward or downward until it reaches a point where the outlines of the flame can be distinctly recognized, but are just beginning to fade. The degrees of the scale, which indicate the distance of the two glass bottoms from each other, are read off, and by comparing these degrees with a table made for this purpose, the fat contents of the milk are found.

Fig. 2 shows the same apparatus, but so constructed that it can be used in the free air, and the light is protected from draughts. When milk is to be examined which has been perfectly skimmed and which contains much less fat and dry matter—for by skimming milk loses from ¼ to ⅛ of its fatty contents—a second scale has to be used. Numerous comparisons with analyses of fresh milk have given very favorable results for the new apparatus; the average difference amounted to only one-tenth per cent., the greatest difference being three-tenth per cent.

ANCIENT AMERICAN POTTERY.

CONTRIBUTIONS TO THE ARCHÆOLOGY OF MISSOURI, by the Archæological Section of the St. Louis Academy of Science. Part I. POTTERY. Salem, Mass.: GEORGE A. BATES, Naturalists' Bureau, 1880. 30 pp. 5 plans and 24 plates. 4to.

The selection by the St. Louis Academy of an archæological subject for the first of its quarto publications is evidence of the increasing and wide-spread interest in all that relates to American antiquities.

FIG. 1.

The immense number of ancient tumuli of various kinds which still exist in the Mississippi valley; the many burial places of unknown or forgotten peoples, and the more recent mounds and cemeteries of the Indian tribes of historical times, scattered here and there on the bluffs and old river terraces of the great valley, mark it as an important region for exploration and study, if we would know of the past inhabitants of our land, their origin, their condition and culture, and the probable causes of their disappearance.

In view of the rapid destruction of these remains by the ow of the farmer and the spade of the curiosity-hunter,

FIG. 2.

we cannot too highly appreciate and honor the efforts of the Archæological Section of the St. Louis Academy to put on record "the results of work and observations in the field by its members." The only regret we have is that the objects obtained from the explorations are not all the property of the Academy, or of some institution provided with a fire-proof building, in which they could be properly arranged and preserved for all time. Fifty years hence, perhaps in half that time, these objects from the mounds and old burial places will not often be discovered, and hence it becomes a sacred duty not only to describe what is found, with all the attendant

FIG. 3

circumstances, but *to secure and preserve all for future study and reference.*

The present memoir opens with an account of the great alluvial tract of about 4,000 square miles in the south-eastern corner of the State of Missouri, in which region the most extensive remains, in Missouri, of the "Moundbuilders" have been found. This chapter is written by Prof. W. B. Potter, after a survey begun in 1876 and continued for two years. In it the author gives an instructive account of the geology and general character of the region, in which he says that its general surface "is but little above the mean

FIG. 4.

stage of water in the Mississippi River. It is broken up into a series of long and comparatively narrow tracts of more elevated arable land, known locally as 'ridges,' and intervening cypress swamps. . . . The 'ridges' are generally quite level, with an average elevation above the swamps of fifteen to twenty feet."

After a further geological discussion, in which Prof. Potter calls attention to the probability that "at the time of the Mound Builders the present swamps were open water courses, since all their principal works, especially the settlements, so far as observed in this region, were situated on the banks of the 'ridges' and not in the interior."

This geological account is followed by a detailed description of the principal ancient settlements to which the present memoir particularly relates, illustrated by plans and maps. Each of these settlements is surrounded by an embankment, outside of which is a ditch. Within the embankment, there are a number of mounds, varying in size and shape, which were constructed for different purposes, and also numerous circular depressions* which are probably the sites of the habitations of the people. Two low mounds in the "Sandy Woods Settlement" proved to be burial mounds, in each of which from one to two hun-

FIG. 5.

dred bodies had been placed. These mounds were about 2 feet high and about 100 feet in diameter. From these alone, between 800 and 1,000 specimens of pottery have been taken.

Four settlements are described as on the "New Madrid and Sikestone Ridge," each containing many mounds. In one, two burial mounds, 9 feet high, one 90 and the other 120 feet in diameter, were explored and a large amount of pottery obtained. In *settlement B*, on this ridge there is a large burial mound which is 21 feet high and has a level top 155 feet long by 110 in width. "This mound is now used as a burial place by the members of the Mound Church, close by, who have thrown out the bones of the unknown heathen to make room for their own dead." The account

FIG. 6.

of this mound is of particular interest, as it is the one which was explored many years ago by Prof. Swallow, and from which, and from another near by, the first collection of any importance of the now well-known "Missouri pottery" was obtained.†

In the summary at the close of his chapter, Prof. Potter calls attention to the fact that the relics found in the region he has so carefully described, are articles for household use, or for ornament, and agricultural tools, with a notable absence of implements of war or the chase, such as are found so plentifully in other parts of Missouri. The pottery is found in great abundance in the burial mounds. Several engraved disks of shell have been found. One of these, 3 inches in diameter, has the figure of a large spider carved

FIG. 7.

upon it, and another, 6 inches in diameter, has a human figure.‡ Among the ornaments are numerous beads made of shell, and one small disk of cannel coal "jet," pierced for suspension.

With this brief notice of the first part of this important memoir, which is necessary for a proper understanding of the conditions under which the pottery described and figured in the second part was found, we turn to the account of

"THE ANCIENT POTTERY OF SOUTHEASTERN MISSOURI."

This part of the memoir, which is by Dr. Edward Evers, is illustrated by twenty-four plates containing one hundred and forty-eight figures, carefully and accurately drawn on stone by Dr. G. Hambach. The objects represented were selected from upwards of four thousand specimens, princi-

FIG. 8.

pally contained in the collections of the Academy, of Prof. Potter and of Dr. Engelmann. The opportunity was thus offered to give a fair representation of the numerous and peculiar forms of this interesting pottery, and as a result we have for the first time a comparatively complete series of illustrations of the pottery of one section of our country, which will serve admirably for comparison with that from other regions. Of course, where individuality is a marked characteristic, as is the case with all early pottery, it is almost impossible, except in the simple forms, to find two or more specimens that actually agree in shape or in ornamentation; but with a large collection from one region it is always possible to designate groups, in each of which the specimens are more closely related to each other than they are to those in the other groups. On making such classifications of pottery from various parts of the world, it will be found that certain groups are in great

FIG. 9.

part common to all; as, for instance, the bowl, the wide-mouthed jar, the pot, and the water bottle, whilst others in each collection are more or less characteristic, and to that extent unlike those from other places. Of course, it is these last, taken in connection with the modifications of the common forms, that should be particularly studied, and it is also to these "typical groups" that we must look in order to understand the state which the art had reached among each particular people. Thus every large collection of early pottery is of importance, for it not only shows the state of the ceramic art reached by the people of the time and place to which it belongs, but it may be, also, to a certain extent, indicative of their culture and probable relationship with other nations.

Regarded in this light the productions in clay by a people,

FIG. 10.

however rude, are of great importance, and it is with this scientific spirit that one must read the pages of Dr. Evers and examine the accurate figures of the Missouri pottery given in the volume under consideration.

In a few pages of general remarks, in which the author expresses his belief "that our knowledge of the *facts* relating to the prehistoric inhabitants of our continent, especially to those who inhabited the Mississippi Valley, is still too meager and uncertain to warrant any definite inference as to their origin, character, and civilization." He states that the present paper is "intended simply as a description of the pottery from the burial mounds in Southeastern Missouri." He also calls attention to the great liability to error on the part of those who make comparisons between

FIG. 11.

the pottery of different nations. While giving this warning he has, apparently from the statement of others and not from personal study, been himself led into a common error when he states that "the pottery of the so-called 'Mound Builders' bears such a striking resemblance to that of the ancient inhabitants of Peru, as well as to that found in the 'cliff-houses,' that this has been quoted as an argument in favor of the theory that these nations were identical," he further remarks that "the argument drawn from the resemblance of ancient pottery at that stage of development can at best be only of corroborative value when taken in connection with other more positive evidence." To this I am forced to take decided exception, for if the pottery of the "ancient inhabitants of Peru" and that from the "cliff-

FIG. 12.

houses" (ancient Pueblo pottery of New Mexico, Colorado, Arizona, and Utah) were, either of them, of the same character as that of the "Mound Builders," it would, in nations so far advanced in culture as the Peruvians and Pueblo tribes, it seems to me, be a fact of the greatest importance in showing these several peoples to be closely related. The fact is, however, notwithstanding the oft-repeated statement to the contrary, that the pottery of the three regions named has but little in common, while between that from the "cliff-houses" (ancient Pueblo) and the "Mound Builders," both the method of manufacture and ornament are radically distinct. Between that from the ancient graves near the coast of Peru and that from the mounds of Missouri there is a slight general resemblance, particularly in the adoption of human and animal forms, but the development of the art itself is in Peru far beyond that of the mounds, and the realistic

* Similar remains in Tennessee I have shown to be the sites of the houses of the Moundbuilders of that region. See 11th Report Peabody Museum, Cambridge, 1878.

† This collection was afterward secured by the Peabody Museum of Archæology and Ethnology at Cambridge, where it is now on exhibition, and it was my fortune to describe the objects in the 8th Report of the Museum, Cambridge, 1875.

‡ These carved shell-disks are in general no mean specimens of early American art, and are of extraordinary interest, as they have now been found in many mounds and stone-graves in Missouri, Southern Illinois and Tennessee, generally associated with pottery of the "Missouri" type. The design on the shells varies as stated above. The human figure on the one mentioned by Prof. Potter, of which a photograph can be seen at the Archæological Museum in Cambridge, is of a peculiarly complicated form, somewhat resembling some of the old Mexican carvings. Others from Missouri and Illinois have a spider engraved in the center, while those from Tennessee represent the rattlesnake, heads of birds, or a number of circles with these divisions, and other forms. Only a few of these ornaments, or possibly "totems," have yet been described, but a large collection can be seen at the Peabody Museum of Archæology in Cambridge.

forms of the two bear no closer resemblance than do either with similar forms from Egypt. It is not to be questioned that the ideas expressed in the ornamentation of some forms of old Peruvian pottery are very similar to those from the mounds, but the method of their production and the character of the art are distinct, and should not be mistaken one for the other. While there is thus, it seems to me, a well-marked difference between the ceramic art of the old Peruvians, the Pueblos, and the Moundbuilders, it would not by any means be safe as yet to state that there is nothing in common in the art between some American nations and some of the early Asiatic peoples. The discussion of the subject here, however, would lead too far, and it is only alluded to in order to emphasize the importance of a careful study of the pottery of any people for its ethnological value.

The Missouri pottery "is made of a dark, somewhat grayish clay [the ordinary 'blue clay' of the region], mixed with sand and shells in varying proportions." I may also add that some of the vessels contain minute particles of

FIG. 13.

charcoal, apparently the remains of vegetable substances destroyed in burning the vessels, and that others seem to be made of unmixed clay.*

Dr. Evers considers that most of the Missouri pottery is simply sun-dried, and that only a few of the vessels are baked. This statement is hardly correct, for while it is likely that none of the vessels were baked in a kiln, there are very few that do not show signs of more or less extensive burning or hardening by fire. A few, it is true, and such are generally thick and poorly made, have not been subjected to sufficient heat to leave its impress upon them, but even these, it is probable, were hardened by being placed near the fire. A series of experiments shows that the majority of the vessels, those which are nearly of the natural bluish-gray color of the clay, were evidently burnt by being placed on hot ashes and coals, and that a considerable degree of direct heat is necessary to change the color of the clay. The dark portions, or blotches, on many of the vessels, are also unquestionably due to contact with flame and smoke, as shown by the experiment of placing unburnt clay on

FIG. 14.

burning wood. An examination of fragments of the pottery will also show that in most instances the outer surface, and generally also the inner, is slightly changed by heat, and we know that from the different methods of burning, practiced by some of the Indian tribes, pottery was burnt hard enough for ordinary use by simply placing the vessel over hot coals and putting hot ashes in its interior, or by inverting the vessel over the coals.† We also know that the dark pottery of the Missouri type is often found in very wet situations, where it has absorbed so much moisture as to be soft inside, while the outer and inner crust is comparatively firm; in fact, under such conditions that, if it were simply sun-dried, it would probably be reduced by moisture and pressure to a shapeless mass of clay. Another experiment has shown that, on cutting away the outside of one of these slightly-burnt vessels, very little moisture was necessary to disintegrate the clay forming the central portion of the vessel, which was not hardened by the moderate amount of heat to which the vessel had been subjected, though it was sufficient to harden the outer and inner surfaces. Many of the

FIG. 15.

vessels, as stated by Dr. Evers, were pretty well burnt, and are quite hard and strong, and ¾ is the jars and dishes of this character that are generally ornamented in colors or are painted red. These colored vessels, however, do not seem to be so numerous in Southern Missouri as in Arkansas and Tennessee, where the same type of pottery, with some local variations, occurs in equal abundance and variety.

The great antiquity which the author of this portion of the volume is inclined to give to the Moundbuilders of Missouri may or may not be the case, but certainly from the knowledge which we have of the pottery and mode of life of many Southern tribes of Indians during early contact with Europeans, the following statement must be received with proper allowance:

"The study of the ancient pottery of New Madrid County teaches us . . . that these early inhabitants had long since emerged from a condition of barbarity, and had attained a degree of civilization and culture, which, if acquired by the slow process which we observe in historic races, will date their existence back centuries before the discovery of this continent." This, it seems to me, is not giving due weight to the known condition of tribes which were living between one and three hundred years ago, in a similar manner, and had a corresponding culture and art, so far as can be inferred from the character of the remains of the Missouri and other Southwestern Moundbuilders. By this I do not intend to question for a moment the probable great antiquity of *some* of the mounds and their contents, but at the same time I do not see any argument that can be

FIG. 16.

deduced to show that the Southwestern Moundbuilders were any higher in culture or of a different race than *some* of the Indian tribes of two or three hundred years ago, and in the character of the pottery considered by itself there is little that is expressive of a very high state of culture. The term "Village Indians," as it is now understood, would probably express the state of culture attained by the Moundbuilders of Missouri, so far as we can judge from the known remains.

After stating the views which he thinks should be considered in describing the development of the art of a people, Dr. Evers writes that "we should check the growing tendency to attribute to every ancient relic more than it actually represents. Too many of the modern investigators are not content with a simple and matter of fact explanation. To them every item relating to an ancient race is of 'great historic' significance, every utensil that is unearthed must have

FIG. 17.

been devoted to some more important and significant use than a corresponding one of the present day; every line of decoration must have some 'hidden meaning;' every grotesque form necessarily represents some worshiped idol, or is symbolic of some religious or secular custom." With this truly scientific spirit every faithful worker in American antiquities will be in full accord, for the absurdities that have been gradually forced into the minds of the people in relation to American archæology have been not only a stumbling block in the way of a truthful interpretation of our antiquities, but are also a disgrace to the literature and the science. From the generally received opinion it would seem that there were in America only temples, palaces, sacred inclosures, places of sacrifice, symbols of worship of the sun, the moon, the serpent, and the phallus, and idols without number.

Again, when describing some of the painted ornaments on the vessels, the author has called attention to the ridicu-

FIG. 18.

lous interpretation given to the common ornament of the circle and the ellipse, which "have been a fruitful source of hidden meanings," while the simple decoration, such as shown on his Fig. 44, "has been explained as a symbolic representation of the subdivision of the year into thirteen months, the four central spaces denoting the four seasons," and truly says that "to us all these are only artistic decorations, simple in design, almost perfect in execution, and exhibiting a refinement of taste which we could not have expected in a people making use of the rude implements which we find in connection with their pottery."

It is almost unnecessary to remark that, in common with all other American pottery free from European influence, these vessels from the mounds in Missouri are not glazed and were made without the use of the potter's wheel.

Dr. Evers states that the plain uncolored vessels with a spherical body and a long cylindrical neck are more numerous than the other forms. A vessel of this character (generally known as water bottles) is shown in Fig. 1.* Most of these water bottles have slightly flattened bottoms, so that they stand upright. Some, however, are provided with special supports in the form of a ring about the base, which is in some plain, and in others perforated or notched. Others are furnished with three distinct feet, which are often hollow and connected with the interior of the vessel. A few instances of "double-necked" bottles are known, and three are figured on the plates of the memoir. In these the "necks," starting from opposite sides, curve toward each other, forming a handle, and unite in a single mouth. Many of these water bottles, as well shown by the figures in the memoir, are carefully decorated by colored bands, stripes, waved lines, circles, stars, and numerous other designs, generally in red and white. Occasionally a dark brown or black pigment has been used. These colors are not burnt in, hence they are easily rubbed off, and are only found in perfection under favorable circumstances. Some of the pottery is of a yellowish color, which is due to pretty extensive burning. Other specimens are painted a bright red, and these are generally well burnt. In some the ocher used for coloring was partially burnt in.

The polish or gloss noticed on the best made specimens

FIG. 19.

is probably due to polishing the vessel with a smooth stone before baking. This method of giving a smooth and glossy surface to pottery does not seem to be generally known to writers on the art in America, but we know that it is the way in which many widely distinct Indian tribes of recent times give the high polish to their pottery, and the appearance of the ancient and modern is the same.† I may also add that smooth stones, in every way similar to stones which are known to have been used for the purpose, are often found in graves associated with polished pottery. Particularly have I found this to be the case in Arkansas and Tennessee, where the pottery is of the same type with that from Missouri. Such stones have been very likely regarded by many collectors as ordinary water worn pebbles and not worth saving.

Probably intended for holding food and valuable articles are the vessels similar to those here represented by Figs. 2, 3, 4, 5, which are of various sizes, and are often ornamented in color with designs of the same character with those on the water bottles. Jars of this shape are often symmetrical, and finished and ornamented with considerable care. Several of this character are beautifully shown in the plates of the volume before me.

FIG. 20.

Bowls and dishes with flat or slightly rounded bottoms, similar to Figs. 6, 7, 8, 9, 10, 11, here introduced, also occur. Generally these have ornamented edges. In some, the rim is scalloped, in others embattled. A few are square or oblong, but the majority of this group are shallow, either with rounded or sloping sides, and with little ornament except about the rims. Occasionally one is found with some slight ornament, either incised or in color, on the inside. A number are known, particularly from Arkansas, which are coated with red ocher on the inside as well as on the outside. As I have already stated, some of these red dishes show signs of having been slightly burnt after the color was applied.

Another group of forms common to many regions are the small pots with two or more handles, such as shown by Figs.

FIG. 21.

12 to 16 on these pages. These are not often very much burnt, though occasionally one is found that has been changed in color by burning. Many, however, show signs of smoke and soot from contact with fire, and it seems very likely, from a study of a large number of these vessels from various places, that they were the ordinary cooking pots. They

* Ninth Report Peabody Museum, Cambridge.

† Dumont, in his account of the method of manufacture of the pottery by the Indians of Louisiana about the middle of the last century, states that "the burning of this pottery does not cause them much trouble. Having dried it in the shade, they kindle a large fire, and when they have a sufficient quantity of embers, they clear a space in the middle, where they deposit their vessels, and cover them with charcoal." Adair states that the Cherokees placed their earthen pots "over a large fire of smoky pitch-pine, which makes them smooth, black, and firm." See Rep. Smithsonian Report, 1866, and Jones, "Antiquities of the Southern Indians."

* The few woodcuts here introduced, in order to illustrate some of the forms of this pottery, are taken from the Ninth Report of the Peabody Museum, and represent vessels which were obtained from the same group of Mounds with many of those described by Dr. Evers.

† The high polish on the thin and hard pottery from old burial places in Mexico was evidently made by the use of stones, several of which, of quartz and other hard minerals, much worn and polished by use, have been found associated with the polished pottery. I may also add that stones are used for the same purpose by the present Indian potters of Mexico.

are, so far as I can now recall, entirely without colored ornament, and their decoration consists of the ruder kind, such as finger-nail marks, incised lines, and indentures made with a stick or a pointed stone. On some, as in all other groups, the ornamentation is made with greater care, and we find incised, crossed, and waved lines, triangles inclosing groups of dots, and numerous other widely distributed patterns of incised work. On others there are raised knobs arranged in rows or otherwise symmetrically disposed. Vessels of this character are occasionally found which are far superior to others associated with them. Among such are the thin and better burnt specimens, and those that have the surface of the vessel divided by grooves or depressions into two or more symmetrical portions.

As it will be impossible to note here all the forms of this Missouri pottery of which the memoir under notice con-

FIG. 22.

tains so many fine and well drawn examples, I must pass to those which are so characteristic of this peculiar ware. Among these are the interesting dishes in which the handles are represented, at least on one side, in a few on both sides, by the more or less distinctive head of some animal. In the majority of these dishes the head is evidently intended to represent that of a bird, generally of a duck, as shown in our Fig. 17. Others are more rudely made, as in Fig. 18. Sometimes, but more rarely, the head is that of a mammal, as shown in Fig. 19. The variations of the method of ornamentation is very great, and in some specimens, particularly among a number from Arkansas in the Peabody Museum, the head of a bird forms one handle, while the opposite represents the tail. On some of these "bird-dishes" the realistic character is further shown by the ridges on each side, which are in the form of wings. On many of the

FIG. 23.

Missouri dishes the handle represents a human head. On some this was rudely executed and may be taken for the head of an owl as well as that of a man, as, for instance, in the specimen shown in Fig. 20. On others the work was more finished, and we have the result shown in Fig. 21. Several forms of dishes of this character are illustrated in the memoir, and one shows two human heads facing each other from opposite sides of the dish. These heads, or handles, were evidently made independently from the dish and luted on. The human heads are generally hollow, and contain several little clay pellets which rattle when the dish is shaken. Dr. Evers is inclined to accept the theory that these interesting dishes were lamps; but as I have found, in the stone grave mounds of Tennessee, several of them in which were spoons carved from fresh water mussel or clam shells of the same character as those found in other dishes

FIG. 24.

and pots, some of which also contained the broken bones of animals that had probably been cooked for food, I see no reason for considering that these vessels threw any more light in the past than they throw at present on the people who made them.

The tendency to realistic art by the old potters of Missouri is shown in much of their plastic work, not only in such instances as already mentioned, but human heads, similar to those forming handles to the dishes, were often used as a rude medallion ornament on water bottles and jars of various shapes. In other instances the vessel itself or some part of it represents an animal or a human head, often of forms like the accompanying Figs. 22, 23, 24, 25, upon which the features are moulded in the clay of a limited portion of the vessel. In others, pieces of clay representing the eyes, nose, mouth, and ears are placed in their relative positions on the body of the jar. Such representations are often accompanied with colored bands or ornaments, as shown in the interesting figure on Plate 23 of the memoir, representing a vessel with two human faces on opposite sides, upon each of which are dark colored bands.

Although several rather difficult and complicated figures in colors are known in this pottery, it is important to note that, so far as I am aware, not a single specimen has ever been found in which the features of man or animal have been expressed in color alone. The nearest approach to this is in a jar of human form from Tennessee, in which the arms and hands are rudely outlined in black.

The decided tendency to the realistic in the ornamental art of the Southwestern Mound Builders is still further shown by the number of vessels for various purposes which are more or less exact reproductions of vegetable, animal, and human forms. Of this character are the dishes made

FIG. 25.

to represent the shells of several species of fresh water mussels (Unionidæ). Not only is the peculiar form of the shell faithfully copied, but the shape and position of the hinge of the particular species are shown with considerable accuracy.

Among the finest specimens of the dark pottery observed by Dr. Evers, he places the finely made vessels of gourd-form. An examination of the six figures on his Plate 22 is only necessary in order to understand the perfection of the copy. These gourd-forms are also instructive in directing the attention to a probable cause of the lateral position of the mouth of many of the vessels which terminate in an animal or human head. In these gourd-forms the mouth had to be placed on the side in order to have room to represent the stem of the gourd in its proper position, and this form having once been adopted would be naturally retained when other styles of ornament, such as human and animal heads, were given to vessels of the same general form, and would also be retained when the body of the vessel was itself moulded either into bird-like or human forms.

Another expression of this realistic art is seen in the vessels somewhat similar in character with the dishes and pots, in which one of the handles is in the form of an animal's head, and to which attention has been already called; but in those to which we now refer, and of which there are a number of illustrations in the memoir, the idea of the potter was to express some particular animal by moulding portions of the vessel so as to form its head, tail and legs, while the vessel itself represented the body. Of this character are many representations of frogs and toads, which seem to have been favorite figures with the potters of Missouri as well as with those of old time in Central America, where these animal forms also occur. In a similar manner the form of a fish was produced, but the vessel has to be placed upon its side in order to get the full effect of the design. In this position the head of the fish will be seen as one handle to the dish and its tail as the other, while the dorsal fin will be opposed to the anal, pectoral, and ventral fins. In some of these fish-forms the fins are not always given with perfect regard to accuracy of position, and in others some of the fins may be omitted, but in all the fish-like form is unmistakable.* Bird forms are represented in a similar manner, the wings forming ridges upon the sides of the opening of the dish, while the head and tail form its handles. In still others the bird form, particularly the owl, is reproduced in a more natural way, as shown by Fig. 26, which is somewhat like two of the figures in the memoir.†

FIG. 26.

* A very important and interesting feature in the ceramic art of the Southwestern Mound Builders, as well as of other American peoples, is that of conventionalism, to which I have called attention in detail on other occasions. A discussion of the subject here would so greatly extend this notice that it must be omitted.

† The author of the memoir states that the owl seems to have been a favorite model, "though it does not occur in our collections as often, nor is it as elaborately finished as in the Cliff house pottery of the ancient races of the Pacific," and refers to Plate 56 of Hayden's Report for 1876 as an illustration of the latter. This is a mistake, for although these bird forms are common among the pottery of the present Pueblos, and the plate referred to in Hayden's Report is marked Zuñian, such realistic forms are not as yet known from the ancient Cliff houses or ruined Pueblos, and their non-occurrence is one of the marked differences between the old and recent Pueblo pottery.

The use of the serpent ornament should be mentioned in this connection, as it is shown on some of the figures. On one water bottle two serpents are represented with heads crossing each other, and on another a serpent is represented as coiled about the body of the vessel.*

Among the many other peculiar designs in this Missouri pottery are the water-bottles which represent the full-length human form lying upon the back, with arms extended along the side, and with the long cylindrical neck of the bottle projecting from the chest and abdomen of the figure. Of similar character is the fish shown on Plate 9 of the memoir, from the back of which arises the tubular portion of the bottle. On the same plate is a beautiful water-bottle, the body of which represents a quadruped, perhaps a wild cat or a panther, standing firmly upon its four legs, with projecting head and curled tail. This vessel is justly regarded as one of

FIG. 27.

the most remarkable and interesting of the Missouri collection. It is well baked, and is ornamented by several waved lines and circles symmetrically arranged.†

Perhaps of all the patterns of this Missouri pottery the most marked are the singular vessels and hollow figures of human form. Two very inferior specimens of this class are shown by the accompanying Figs. 27 and 28, but they will give a better idea than words of the character of these interesting objects in the absence of the Academy memoir, in which a number of these comparatively common forms are figured. Most of these represent women in a nude condition;

FIG. 28.

only a few have been found representing men. While all are extremely naturalistic, but few are known which could be classed as immodest. The majority were evidently simply vessels of the same character as those of other designs, such as the owl and the gourd. Some, however, while hollow, are without any external opening, and could not have been used as a vessel. It has been a favorite theory with many collectors, but in which the author of the memoir under notice does not seem to share, that these last were idols, and they are often so called, but to me they are far more likely to be simply the playthings or "dolls" of children. In this view, I am confirmed by the fact that some dozen or so of similar form, some hollow and others solid, which I have collected in the stone graves in Tennessee, were found in the graves of children.

In what has preceded attention has been called to several points which it seems important to consider when our thoughts are turned to the pottery of the Mound Builders of North America. The study of this art in its relation to American Ethnology, however, has but just begun, and there are many other interesting considerations that will occur to those who peruse the pages and examine the plates of this most important contribution to the arts of the Mound Builders, which we hope will be followed by many other similar memoirs of St. Louis Academy.

F. W. PUTNAM.

ANCIENT WARRIORS UNCOVERED.

THE excavations undertaken by the Greek scientist, Stamartakis, upon the battle field of Cheronea, have led to a most remarkable archæological discovery. According to the writings of Pausanias and Plutarch, in the year 338 B.C., 30,000 Macedonians, under the command of Philip and his son Alexander, then but 18 years of age, annihilated the united forces of the Athenians and Thebans at Cheronea, which is situated on the plain extending from the foot of Mount Parnassus. The encounter was so deadly, and the slaughter so enormous, that the river which traverses the plain, the bed of which river is now dry, received therefrom the name of Hamon, signifying the blood river. The "holy band" of the Thebans, consisting of 300 heroic young men, which only took part at the conclusion of the battle, was entirely destroyed, the bodies being interred together upon the battlefield. This troop of 300 glorious dead have now, after the lapse of some two and twenty centuries, been discovered and brought to light by the exertions of M. Stamarta-

* The serpent is also a common ornament on ancient pottery from Mexico, Central America, and Peru.

† A vessel of this character representing a bear, which I took from a stone grave in Tennessee, is figured in the Eleventh Report of the Peabody Museum.

kis, and, remarkable to add, exactly in the form in which they were buried. Five minutes' walk from the village of Cheronea, which is now named Capraona, are scattered the limbs of a colossal monumental lion, destroyed by the stupidity and avariciousness of the inhabitants, who believed that beneath its base hidden treasures would be discovered. Thus this gigantic block of marble, erected to be an everlasting testimony of the glorious deeds of the mighty dead, had been undermined and blown up. It is on this spot that for some months past excavations have been carried on, the first discovery being that of a wall, which, upon being laid bare, was found to be 25 meters long, 15 meters wide, and over 2 meters high, resting upon a foundation 1½ meters in depth. In the parallelogram formed by this wall the excavators found, at a depth of four meters, the remains of 185 Thebans resting upon the clay soil, in parallel rows of 40 men, side by side, exactly in the position in which they had expired. Several rows of these glorious combatants have already been uncovered, the heads of the lower rows resting on the feet of the ones above. All the corpses bear the traces of the severe wounds from which they died. The two thighs of one man have been pierced by the point of a lance; the jawbone of another has been smashed; the skull of a third terribly mutilated; while a fourth, of whom the head is wonderfully preserved, has his mouth half opened, seemingly in the act of breathing, and this latter it is intended to remove to the Museum of Antiquities at Athens. It is especially remarkable that the whole of the remains of these heroes of the town of a hundred gates still retain their teeth complete. No weapons were found, as these were usually taken from the vanquished, but a number of bone buttons, pierced in the middle, were discovered, and two handled earthenware pots. The excavations will be continued in order to discover the remaining 100 companions of the Theban phalanx and the two memorial stones on the right and left of the lion of Cheronea, which was erected to preserve for future generations the names of the noble 300. M. Stamartakis is preparing a detailed report of this interesting historical discovery, and a series of drawings, which will be added to the report, will give the position of each combatant. Six of them will be preserved in the Athens Museum, and the remainder will be restored to their 22-century old funereal resting place within the Halls of Time.—*London Globe.*

THE ANIMALS OF THE DEEP SEA.

DR. H. ALEX. PAGENSTECHER, Professor of the University of Heidelberg, has just published a highly interesting pamphlet, of which the *Ausland* gives the following extract:

"It is only recently that a systematic investigation of the biological and physical conditions of the sea has been commenced. The labors in this direction were at first not induced by interests of science, but the impulse was given by the wants connected with submarine telegraphy. The extension of fishery also made it desirable to gain a more exact knowledge of the treasures which the liquid elements so jealously hid from view. The first methodical investigations of the deep sea produced such splendid results for science that everywhere great zeal for further researches was awakened. Scientific interests are, at present, the chief motive of these investigations, and it is a good sign that the labors in this direction have taken an international character, all nations making it at present a point of honor to be able to contribute to the scientific knowledge of the sea.

In earlier times the knowledge of the fauna of the sea was limited to only such animals as were of practical use, or those which were found accidentally upon the shores at low tide.

Nevertheless, since the most remote times, man has understood how to gain from the depths those objects which would contribute to the comfort of his existence. Oysters were already used for nourishment in prehistoric times. A proof for this fact is the so called "kitchen remains" (küchen reste) on the eastern coast of Jutland and other places, and the Roman authors speak of an artificial propagation of those animals. In India pearls were known in the most remote antiquity, and the method for obtaining them has not changed for centuries. Sponge fisheries were a well paying trade at the time of Aristotle. Coral fishery is also of ancient date. But all these earlier labors of trade have done little or nothing for the knowledge of the sea and its inhabitants. It remained to our century to lift the veil which covered the secrets of the submarine world.

It is true, it happened occasionally, that here and there, one or another of our scientists displayed some interest in the researches of the water. So in the year 1752, Adriaanz, an inhabitant of Jutland, who made some investigations near Greenland, discovered, at a depth of 250 fathoms, a remarkable submarine animal, *Umbellula groenlandica*. The British seafarer, John Ross, also added something to our knowledge of the fauna of the sea. During his researches regarding a north-western passage beyond the Arctic circle, in the year 1818, he discovered, at the depth of 800 and 1,000 fathoms, several kind of animals, which, on account of their shape, have received the name *Caput medusæ*. His nephew, Sir James Clark Ross, did even more. He was the first to bring to light a full specimen of the deep sea fauna (at from 270 to 300 fathoms deep), consisting of living corals, bryozoæ, worms, snails, and crabs, but these discoveries were more accidental than otherwise. Edward Forbes was the first to make methodical researches of the distribution of animals in salt water. The Mediterranean Sea was explored by him in several directions, and the results he obtained became the basis for a system of the distribution of the fauna of the sea. He discerned eight zones of depth, of which the uppermost as far as two fathoms contained the greatest number of animals. At 300 fathoms depth there seemed to be no longer life.

The incorrectness of Forbes' theory is partially due to the peculiarity of the basin examined by him. The small breadth and depth of the Strait of Gibraltar prevents the entering of the cold undercurrents, and therefore the exchange of gases, and for the same reason the animals of the deeper zones cannot enter into the waters of the Mediterranean Sea. The volcanic condition of the bottom may also account for the peculiarity discovered by Forbes.

Austen, after the death of Forbes, was obliged to correct the mistakes of the theory of the latter, which were the result of generalizations upon the conditions peculiar to the Mediterranean, in limiting the zones to four. He discerned a strand-zone, a zone of the band-algæ to the depth of 15 fathoms; a zone of the corallines to the depth of 50 fathoms; and a zone below the depth of 50 fathoms, the zone of the deep-sea corals.

Later investigations proved that Forbes' idea about a lifeless depth was an error. Since there has been obtained conclusive evidence of life existing in the bottom of the sea, expeditions have followed one upon the other, and investigations have been made, in relation to depth, currents, temperature, pressure, gaseous contents, chemical condition, fauna and flora, and their relation to light, etc. The results obtained cannot yet be intelligently classified, but this much can be said with certainty, that the knowledge of the distribution of animals in the sea is an important chapter of animal geography, and promises to become a key to the history of our earth, for, notwithstanding the great extension of the submarine fauna, the relations are comparatively simple.

Professor Pagenstecher says: "What in its properties seems to be a special district of creation, is only the final result of dislocations, of animal properties, and territorial formation. During its origination and distribution, the race partially resists the force of local adaptation. It has to contend with the history of the earth, by which, gradually or suddenly, its habitations are favorably or unfavorably transformed, extended, or limited. Never has anything come into existence which was not permitted by the surroundings; but whatever came into existence was conditioned by that which existed before. Whatever lives is a document for the history as well as for the properties of a territory.

"Paleontology has, before the knowledge of geographical distribution, thrown light upon the epochs of the earth. Its basis lies chiefly in the materials deposited on the bottom of the sea. There precipitations surround the organic remains, protecting them, entered into connection with them in exchange, and preserved to us the forms of beings that lived together during unmeasurable periods.

"Sea animals enable us to combine two important factors of the history of the earth, viz., geographical distribution and geological sequence."

The identic results of investigations regarding the marine fauna which were made in a thousand different places and in regions far distant from each other, have given us fixed data for the life in different depths. This life has especially two directions, one tending toward the life on the surface, the other toward that on the bottom. "The distinction is not sharply defined, because that which walks mostly swims, and because animals which have grown up later have swimming juvenile forms; but the consequence is that the zone near the surface and the zone near the bottom are more rich in animal life than the intermediate zones."

The greater the depth the less would migration on the bottom or swimming procure for the animals conditions differing from those to which they were accustomed hitherto. From this it follows naturally that in those regions even over great distances very little variety occurs in the fauna. According to the law of utilities migrations in great depths are rare, and the forms to be found are stable and indolent. Conditions being equal over great distances, certain genera obtain a great geographical distribution. It is true also, that local conditions have an influence even in great depths, as in the green zone. The mighty rivers of America and Asia often condition for hundreds of miles the animal life in the sea even in the lowest regions, and coral reefs produce other conditions for animal life than the volcanic islands do.

It would lead too far to follow Professor Pagenstecher into details, and we will only glance at his remarks in regard to the several genera found in the different depths. As regards fishes and other animals that swim in open water, that are caught in ground nets, it is always uncertain whether they have really lived in the depth where they were caught. We may, therefore, overlook them, and will first speak of the crabs. These constitute nearly 20 per cent. of all animals which live at the depth below 1,000 fathoms. Triangular crabs are the best adapted to live in the lowest regions. The origin of the garneel crabs is still somewhat doubtful, although they are always found in the ground net. The family of the rhizopodes has numerous representatives in the deep sea, and so also has the order of cumaceæ. Copepodes are found in great number in all seas at all depths. Cirripedia have been found at a depth of 2,850 fathoms.

Snails and genuine shells do not usually go very far down into the water, but stylifer snails have been caught living at 2,650 fathoms, and slime shells at 2,740 fathoms. Brachiopodes are found east of the Philippines at a depth from 2,000 to 2,475 fathoms, but they are also found single in the Atlantic Ocean at a depth of 1,503 fathoms. Bryozoæ belong to those animals that are found in the lowest regions. Near Japan they are found in a depth of 3,125 fathoms. In otherwise sterile regions they are found at a depth of from 2,000 to 3,000 feet.

Many kinds of bristle worms have been found at the same depths, often they alone are found in the lowest regions. Mud worms belong mostly to shallow depths. In New Zealand only, there has been found one kind, at a depth of 1,100 fathoms.

Echinoidermes are numerous and varied in regions not exceeding 100 fathoms, and they constitute chiefly the character of those regions. In those depths of the Antarctic regions which exceed 1,000 fathoms, they are still more abundant than the crabs, but only a few representatives of them are found in the lowest depth. Star fishes have been found in depths as low as 3,000 fathoms.

The hydroidpolyps are wanting neither in high latitudes nor in great depth, and actiniæ exist in depths of 3,000 fathoms. The corals of the deep sea usually live in colonies upon rocky ground, are mostly solitary, turbinolides. Nearly all genera may be dated back to the tertiary period, many even farther. According to Moseley, ten genera are found as deep as 1,000 fathoms; four at 1,500 fathoms; and in the region between 1,600 and 2,900 fathoms, only *Fungia symmetrica Pourtalès* are found. In the greatest depths there exists at least one species of umbellula.

From all this may be seen what enormous amount of labor is summed up in the pamphlet of Professor Pagenstecher, and although unseeming in exterior it has the highest scientific value.

SCALE INSECTS.*

THERE is no group of insects which is of greater interest to horticulturists to-day than that family which includes the creatures popularly known as "scale bugs." No variety of fruit is exempt from their attacks, and in certain localities many trees have been seriously injured, or even killed outright by them. The oyster shell bark louse of the apple, and several species infesting citrus fruits are well known examples of these facts.

Notwithstanding the great importance of the subject, comparatively little thorough work has been done on the species of this country. This fact led me to undertake a serious study of the group, the result of which will be published as soon as practicable.

The object of the present paper is simply to give for the benefit of California horticulturists a few of the more important points in the life history of scale insects, and a part of the results of my studies of the forms which occur on this coast.

The scale insects or bark lice comprise the family known to entomologists as the *Coccida*. In many respects this is a very anomalous group of insects, differing greatly even from closely allied forms in appearance, habits, and developments.

The newly hatched scale bug is oval in outline, much flattened, furnished with six legs, a pair of antennæ, and an apparatus for sucking the juices from plants. At this stage of its existence it is very small, a mere speck, which the untrained eye could only with difficulty detect. By means of a lens, however, they can be seen crawling in all directions over the leaves or bark of an infested tree. After wandering for a time the young coccid settles on some part of the plant, inserts its beak and begins its growth at the expense of its host.

From this point the development of certain species is quite strange, appearing to be a retrogression instead of an advancement to a more highly organized form, as is the rule in the development of animals. The skin is shed, and with it the legs and antennæ. The coccid thus becomes a degraded grub-like creature, with no organs of locomotion. The mouth parts remain, however, in a highly developed state, and well fitted to perform their functions. This apparatus is not the least remarkable thing in the structure of these insects. It is terminated by a thread-like organ, which is frequently much longer than the body of the insect, and is composed of four delicate hair-like bristles. By means of this organ the insect is firmly attached to the plant and draws its nourishment therefrom. From this stage the development of the sexes differ.

The female coccid soon moults a second time, and this shed skin is joined to that first moulted and forms a covering or scale, under which the insect is to pass its life. The moulted skins are, however, insufficient to cover the body of the coccid, which increases in size rapidly. To supply this deficiency a waxy matter is secreted by the insect and successive additions thus made to the scale. The different modes in which these additions are made form some of the characters by which the different species of scale insects are most easily distinguished. For example: If the waxy matter is added to one side of the moults and successive additions made to the same side, a long and more or less narrow scale is formed. The common oyster shell bark louse of the apple and the long scale of the orange, well known in Florida, are illustrative of this kind of scale insects. If the waxy matter be added to all sides of the moults, and successive additions are in the form of concentric rings, a circular scale is formed. To this group belongs the so-called "red scale" of this State, and a species which I propose to call the Cuba scale, which occurs in a single grove in Florida, as well as the scale most destructive to fruit in the Santa Clara Valley. In each case the scale is nearly circular and the moults appear at a point in the center. Numerous other forms of scales occur, but these are sufficient for our present purpose.

After the female reaches maturity the process of oviposition begins. The eggs are laid under the scale, the body of the female gradually diminishing in size as the eggs are laid, thus making room for them.

A word now respecting the development of the male. In the group of scale insects which I am now considering the male scale can be distinguished by its small size and the fact that but a single skin is moulted in the course of its formation. When the male bark louse attains its growth it changes to a pupa with rudimentary legs and wings; later it undergoes another change, and emerges from under the scale an active little creature furnished with long legs and antennæ and two large but very delicate wings. Its mouth and its appendages have disappeared, and in their place has been developed a second pair of eyes. Of course no nourishment can be taken during this stage of its existence, and its energies are devoted solely to the perpetuation of its kind.

A SECOND GROUP OF SCALE INSECTS.

A second group of scale insects differs from that just described in that the species do not excrete a scale-like covering, composed in part of moulted skins, and the females preserve their legs and antennæ throughout life. The form of the body of the female, however, usually changes greatly after impregnation. Of many species of this group the males are unknown, but in all the cases where they are known they are winged, as in the first group. The most familiar representation of this group are the "black scale," or "brown scale" of this coast, and the "soft scale" of Florida. With the black scale, after impregnation the body of the female becomes much thickened and elevated, assuming the well known characteristic form. After that the sides and back of the insect become much hardened, and the minor part shrinks away from the plant as the eggs are laid. Thus there is formed a cup-like shell, or "scale," which covers the eggs and newly-hatched young. It should be borne in mind that this "scale" is the hardened body of the dead or dying female, and not an excretion separate from the body of the insect. This point is of practical importance, for it is easier to destroy a naked insect than one which is furnished with a water-proof covering like that of the scales of the first group.

A THIRD GROUP OF SCALE BUGS.

In the third group of scale insects the females change very little in form during their entire life, and do not become fixed in one place. The males are winged, as in other groups of coccids. The mealy bugs, so common in hothouses, and the cochineal insect, are the best known examples of this group.

THE FORMS OF SCALE BUGS OCCURRING ON THE PACIFIC COAST.

These few remarks will give a general idea of the natural history of this family of insects. Now as to the forms which occur on this coast. Up to this time I have studied fifteen species which infest cultivated plants in sufficient numbers to prove injurious. These will be described at length, with others occurring in the East, in a report which I am preparing for the Department of Agriculture. The most common species of this State is the "black scale," which is very abundant on citrus trees and olives, and also infests many other plants, including the deciduous fruits. This agrees with descriptions of a common European species—*Lecanium*

* A paper read before the California Horticultural Society, by Professor Comstock, of the Agricultural Department, Washington.

olex—and I presume will prove to be the same. If this be true, the species was doubtless brought from Europe on citron trees. Another very important species is that known as the "red scale." This is as yet undescribed. I have, however, in manuscript, ready for publication, a description, including figures of different stages and both sexes. There is abundant proof that this species was introduced from Australia. These two examples are sufficient to show the danger of introducing pernicious pests with exotic plants. The same thing has happened in Florida. Although the two species just mentioned do not occur in that State, one very closely allied to the "red scale" has been introduced from Cuba. And another, the most common on orange in that State, is a European species. All of these insects, however, are not foreigners. For example, there is an undescribed scale common on olive, pear, fig and other trees in this State which I have good reason to believe has spread in the cultivated trees from the native willows. And in Florida there is a scale which is quite common on citron trees and other plants, which I believe has spread from the gall berry, an indigenous bush very common throughout that State.

HOW THE SCALE INSECT IS SPREAD.

A word as to the mode of spreading scale insects. As I have already stated, with most species the adult female is firmly attached to the plant upon which she lives; she is consequently a "stay-at-home body." And although the adult males are winged, it is obvious that the pests could not be spread by the flight of that sex alone. The newly-hatched young of both sexes, however, are very active, crawling about from one part of an infested tree to another, or even to other trees which may be near. It doubtless often happens that these tiny creatures are brushed from the trees by persons or vehicles passing, and are thus distributed. Or they may crawl upon the feet of birds, and thus be carried long distances. But the most common mode by which these pests are distributed is by the transportation of trees and fruit infested with living scale insects.

METHODS OF PREVENTING THE PEST.

These facts suggest the following methods for preventing the occurrence of these nuisances. In planting an orchard, choose as isolated a place as is practicable. If isolation cannot be obtained, induce your neighbor to join you in your efforts to grow clean fruit. Use the greatest care in purchasing trees or importing buds. Before planting, thoroughly wash all such trees with an insecticide, even if they appear to be clean, for the untrained eye may fail to detect early stages of these insects. Do not visit infested orchards unnecessarily, and above all things do not carry home specimens of scale bugs as curiosities. Watch your trees carefully, and if one is ever found to be infested with scales, remember that no better investment can be made than to burn that tree, and that no time is so good for doing it as the day when it is first found to be infested. The system of exchange of fruit boxes is a very dangerous one. Each shipper should have his boxes marked, and insist on not receiving boxes belonging to other shippers.

REMEDIES FOR EXTERMINATING THE PESTS.

In many cases, however, the pests have gained such a foothold that these methods of warfare are impracticable, and a remedy which will destroy these insects without injuring the tree is desirable. I have begun a large series of experiments with different substances, hoping to find such a remedy. These experiments are as yet incomplete, and I will only state that so far I have found nothing more desirable, taking into consideration its value as an insecticide, its effect upon the tree, and its cheapness, than a strong solution of whale-oil soap. This I apply with a fountain pump or garden syringe. And as it is impossible, almost, to thoroughly wet every insect by a single application, several are usually necessary.

Many other substances have been tested, and the results of the experiments will be published as soon as practicable.

I will add, however, that I have seen most excellent results in the orchard of V. C. Mason of San Jose, from the use of the following mixture:

One pound concentrated lye,
One pint gasoline or benzine,
Half pint oil,
Five gallons water.

SMUT ON ORANGE TREES AND OLEANDERS.

Associated with certain coccids, and especially with those which do not form a scale-like covering to the body, as has been already described, is a black substance covering the leaves and fruit. This is very abundant in this State on oleanders, oranges, and other plants infested by the black scale, and in Florida on trees infested by the mealy bug. It is popularly known as "smut." It is a fungus, and has been determined by Prof. Farlow of Harvard, as *Fumago salicina*, a species which has long been known in Europe on olive and orange trees. It is a very serious pest, marring the appearance of plants, and, in certain sections of this State where it covers oranges, greatly reduces the market value of the fruit. An excellent paper on the natural history of this fungus has been published by Prof. Farlow in the "Bulletin of the Bussy Institution of Harvard University," in which the following paragraph occurs: "The result of our examination of the diseased orange and olive leaves is briefly as follows: The disease, although first attracting the eye by the presence of a black fungus, is not caused by it, but rather by the attack of some insect, which itself deposits some gummy substance on the leaf and bark, or so wounds the tree as to cause some sticky exudation, on which the fungus especially thrive. It is not denied that the growth of the fungus greatly aggravates the trouble already existing by so incasing the leaves as to prevent the action of the sunlight. We only say that in seeking a remedy we are to look further back than the fungus itself—to the insect, or whatever it may be which has made the luxuriant growth of the fungus possible."

My own observations confirm these conclusions. In fact, before I had read Professor Farlow's paper I had learned to consider the presence of fungus on the leaves as a sure indication of the presence of scale insects. And as I had never been able to find the fungus organically connected with plants, but simply growing over the surface of them near the coccids, and easily removed by rubbing, I supposed that it grew upon the honey dew which the insects excreted, and which so frequently attract the visit of the ants. This honey dew is doubtless the gummy substance which Professor Farlow observed. Professor Farlow suggests, as a means of destroying the fungus, the use of alkaline soaps as strong as the tree will bear. If our conclusions respecting the fungus be true, this remedy will be a very effectual one, for it will destroy the scale insects which render its presence possible.

An interesting fact which I have frequently observed is that where there is a luxuriant growth of this fungus, it not only feeds upon the honey dew, but attacks and destroys the young coccids themselves. Thus in some instances I have found a large proportion of the young coccids on a leaf destroyed in this way, and when the remains of the insects were examined with a microscope, the fungus was seen projecting in great quantities from them. At first thought this would seem to be a natural remedy. But I find that it is rare that coccids are destroyed except upon the upper surface of the leaves, where the fungus is most abundant. This is probably due to the lodging of the falling honey dew chiefly on that surface of the leaves, and the consequent confining, as a rule, of the fungus to that part, and there always remains a sufficient number of healthy coccids on the lower surface of the leaves to restock the plant.

CATTLE AND DAIRY INTERESTS OF KANSAS.

A RECENTLY issued report of the Kansas State Board of Agriculture speaks of the peculiarly favorable situation of Kansas for the successful growing of cattle. The growth of the cattle interest of the State is shown by the following table:

	No. of Cattle.	Value.
1874	749,959	$13,424,273.00
1875	703,323	14,786,970.63
1876	700,624	15,830,672.00
1877	780,988	17,650,328.80
1878	872,243	19,865,508.40
1879	976,643	24,401,172.00
1880	1,109,781	27,743,275.00

The following tables record the development of the dairy interest of the State:

	No. of Cows.	Value of Cows.
1870	123,440	$4,619,124.80
1875	225,028	5,747,215.12
1876	227,274	6,363,672.00
1877	261,642	6,541,050.00
1878	286,241	7,442,266.00
1879	332,020	8,694,540.00
1880	363,847	9,096,175.00

Butter	No. of lb.
1870	5,022,758
1875	8,827,810
1876	9,804,219
1877	11,710,296
1878	13,790,374
1880	16,905,344

Cheese.	
1870	226,607
1875	1,240,610
1876	644,076
1877	1,007,073
1878	1,005,958
1880	703,447

SOME NATURAL HISTORY NOTES REGARDING THE JEWS.

ALTHOUGH much has been said and written regarding the Jews, they have hitherto only been regarded either from a political or ethnological point of view, therefore it may be interesting to study them from a scientific standpoint, and to consider their anatomical and physiological peculiarities.

That the Jewish race in all latitudes, and under the most various political and social conditions, have preserved a characteristic form and physiognomy is a long established fact. They all bear the stamp of oriental origin, having a comparatively long trunk, small extremities, black eyes and hair, a peculiarly sharp nose, a somewhat upwardly inclined protruding chin, lean body, x shape legs, a quick characteristic gait, and their abnormal dialect.

The fact that some of these characteristics, as the color of the eyes and hair, the x shaped legs and lean body, are not always present, is only in accordance with an experience made by, Darwin and others, viz., that of the variability of single traits within the race or species.

Two of the most important peculiarities of the Jews are the relative proportions of the trunk and extremities, and the height of the whole body compared with the distance between the points of the middle fingers of the outstretched arms.

The following are the results of the same measurements of the bodies of the Jews in comparison with those of some other nations, taken from tables compiled by Dr. G. Schultz, conservitor of the Anatomical Museum of St. Petersburg, which were published in the *Bulletin de la Classe physico-mathématique de l' académie Impériale des Science de St. Petersbourg*, No. 87 and 88, and which give the height of the Russians, the Jews, Circassians, Lettonians, Negroes, Esthonians, and other nations in Asia. Among all these the stature of the Jews is least. The height of the males of these averaging only 65·48 inches, while that of all the other nations was between 67·20 and 69·24 inches. Still more remarkable is the fact that the height of the Jews was in all cases greater, sometimes by an inch, than the distance between the fingers of the outstretched arms, while in the other nations that distance exceeded the height in some cases even to the extent of 8·12 inches.

By dividing the given length of the body into a thousand equal parts, the head and neck of the Jews amount to 185, of the Russians to 184, Lettonians 179, Tshuwashians 180, and the Negroes 182. The perinæum of the Jews was removed farthest from the head, and measured 453 from the foot, while in other nations it was in average 460, in Negroes even 490 from the foot. The navel of the Jews was 581 from the sole, while that of the Russians was 598, of the Lettonians 590, of the Tshuwashians 597, of the Esthonians 597, and of the Negroes 600. The forearm of the Jews measured 148, while in all the rest its length was over 150, and in the Ethonians 157. The leg of the Jews from thigh to knee measured 254, while this part of the leg in the other nations measured 264, and the Lettonians 267. These measurements are in accord perfectly with our observations and other statistical records, especially those of the military offices.

Since their dispersion the Jews have always proved bodily weak, cowardly, and more passive than active. Their aversion to manual labor is general, and this may be accounted for anatomically, by the shortness of their extremities, their bodily weakness too, may account for their cowardice, which has made them a subject for scorn to the hardy races. As a farmer, as a sailor, as a miner or machinist, a Jew will be of little use, and this is why they do not engage in these kinds of industry.

This race has also its physiological peculiarities, as follows: (1) Comparatively small extension of the bodily formation as well as of mental activity, (*a*) great fertility, (*b*) longevity, (*c*) a surplus of male births. The exclusiveness of the Jewish race for four thousands years accounts for the peculiar direction of the development of their minds and bodies. The inheritance of parental qualities is a law of nature, and no great variety of characteristics can be produced without a mixture of genus and species.

Darwin has proved that by inheritance the peculiarities of parents who are of the same species become more and more striking, in compensation, as it were, for other traits which weaken and disappear.

The Jews have developed great mental activity and ability, but this is balanced by another mental defect. As a race they have never been productive, neither in the cultivation of the soil nor in trades, nor in science nor in art. Since their dispersion they have lived from the profits not of their own productions but of those of others. Having a keen sense of perception they are able to accomodate themselves quickly to all conditions and to take advantage of their situation. Vamberg relates that in Asiatic steppes, they are conjurers, fortune tellers, musicians, or clowns; amongst the Turcomans, they are horse dealers and slave dealers, while in other countries they are actors, virtuosos, critics, journalists, lawyers, physicians, etc. Whatever profession they choose, they are sure to excel in it, for they always choose that for which they are best fitted.

As regards their fertility their whole history furnishes ample proof of it.

In Prussia and in Austria, the Jews have increased much faster than the other inhabitants, especially since 1848, *i. e.*, since they have had permission to settle down in these countries without restriction. In Prussia the Jewish population increased from 1822 till 1840, 14·02 per cent., and from 1841 till 1866, 15·82 per cent; while the increase of the general population was, from 1822 till 1840, 10·40, and from 1841 till 1866, 10·43 per cent. (Prussian Statistics vol. 48. p. 28.)

In those countries of Austria which are represented in the "Reichsrath" these wise population increased from 1830 to 1850, 1·70 per cent. and from 1850 to 1869, 3.80 per cent.

MEXICANS AS A "PRIMITIVE PEOPLE."

Editors Scientific American:

In your issue for April, 1880, p. 213, I find an allusion to "*A Primitive People*," affording another illustration of an oft repeated assertion, "the ignorance of Americans with regard to the mode of living of their nearest neighbors is incredible."

The example of Chiapas and Tobasco, there referred to, as a discovery of some gentleman connected with the Tehuantepec enterprise, is the rule throughout the so-called "Republic," retired from the sea-coast. It is only near a seaport that exceptions are found to this rule.

Iron, previous to the war of '46 (which for the masses of Mexico was the most fortunate event of their entire history, being, as it was, the first lesson in civilization received in the space of three centuries, and one which they took advantage of and reaped therefrom incalculable advantages), was almost unknown in the interior, and its use monopolized by the wealthy, commanding never less than 75 cents per pound. Where it was possible to do so copper was then substituted; thousands of houses standing to-day, with copper window gratings and other fixtures, household and kitchen furniture, testify to the fact. But many of the ancient customs have been abolished since the American advent, especially the beef-skin hat, with the hair out to shed better the rain; and the substitution of American prints at 12½ or 18 cents for the domestic shirting of three-eighths wide, at 50 cents per *vara of 33 inches*, when all foreign textiles of the most ordinary class sold for $3 per vara.

The American army, as well as those pioneers of civilization, the bold and brave Missouri trader, broke down and broke up so many wagons passing over rough roads in every direction that they glutted the iron market for half a century; to this day it is a drug, and in the most remote places can be had for a song.

As Mexicans never know the use of anything that is not made of raw hide, ox chains of the best quality could scarce be given away, and when sold brought from 25 cents to 50 cents at the highest.

That primitive pair of stones for grinding corn, and which was doubtless invented by the first farmer produced from the land of "*Nod*," is still in use in every family in Spanish America.

The lady of the house at which you may be a guest will accompany you at table, and pretend to dine, but, so soon as it is possible to retire, she will resort to the kitchen to dine heartily with her servants from the "Aztec" corn bread, called tortilla; all this, provided you are a foreigner. Of course, if she knows you to be of Spanish descent, they are introduced without scruple to the board for all to partake.

H. D.

San José del Cabo.

A NEWLY-DISCOVERED OASIS.*

ABU-NAIM, located in the Sahara, sixty miles from the Mediterranean coast, is crossed by the 29° north latitude and 19° east longitude (Greenwich). The oasis is about one hundred and sixty-six feet above the level of the sea, and has an extension of about seven hundred and twenty square miles. The chief streams, or wadis, are one, which comes from south or southwest, and is called Uadi Abu Naim, and the Uadi Abu-Hassan, which empties into the Uadi Abu-Naim. The oasis, which is about as large as Djofra, is not sharply defined; the traces of vegetation cease so gradually that it can hardly be called a genuine oasis. This uncertain character is proper to that whole country. There are no mountains, for even that mountain chain which is indicated on the maps by the name Harudj cannot be called such. Each thing merges into the other. There is no plain, and there are no connected hills, and if the Uadian (plural of Uadi, empty river bed) were not marked by vegetation, we might say there was neither desert nor oasis.

Abu-Naim has about the same extension from north to south and from east to west. From the many rocks that surround it, and which are partially distributed through it, the landscape presents a very picturesque scene. The rocks are lime and sandstone, and contain large layers of petrifactions, which would be the joy of every paleontologist.

*Extract from an original article by Dr. Gerhart Rohlfs, the well-known German traveler in Africa.

Ostreæ, Patelidæ, Turritellæ, Conus, Ammonites, and others are found in great numbers, while Nummulites have not yet been discovered. They seem to be wanting in the Central Lybian Desert; for even those petrifactions which were collected by Sokus, and which so nearly resemble the Nummulites, are, according to Zittel, Orbitulites. In the sandy ground of the oasis a great number of the foraminifera are found, having sometimes a diameter of nearly half a line. The ground of Abu-Naim is excellent, being sand, mixed with marl and small lime particles, and would be perfectly well adapted for good agriculture if the chief thing were not wanting, viz., good water.

It is a remarkable fact that a great quantity of sulphur is found in many parts of the oasis, and the whole region of the large Syrtes contains rich layers of sulphur. By Arabic geographers the whole bay of the large Syrtes is called Djun el Kibrit, *e. i.*, Sulphur Gulf. It is also well known that the founder of the Egyptian dynasty of the Mehemed Alides, Mehemed Ali, imported sulphur from the Sulphur coast. In the extreme southeast corner of Abu-Naim there is a locality called Hofrat el Kibrit (sulphur mines), and about twelve miles from that place we made our camp.

In the neighborhood we also found sebcha formations and djef-djef fields,* which, like those of the sebcha, are mostly formed by polygonal clods. The sebcha formations are found in every oasis of the Sahara, and it is not true that palm trees cannot grow in the salt ground; on the contrary, just this kind of ground is well adapted for the growth of palms, which bear a delicious kind of fruit; but the water of the sebucha (plural of sebcha), on account of the great quantity of salt which it contains, is still less drinkable than that of the sulphur springs. These latter are found in a rocky ridge of limestone, which crosses about the middle of the oases, from northeast to southwest. The water is contained in small cavities, which usually have a depth of about seven feet, and the subterranean resources of these natural wells seem to be inexhaustible. The temperature of the water, which fills the cavities to the brim in the mouth of March, when we visited Abu-Naim, had a temperature nearly equal to that of the air, the latter being 73·6° F., the former 72·5° F. The neighborhood of these sulphur wells offered a very disagreeable resting place on account of the vapors of sulphureted hydrogen which filled the air and the water which we were obliged to drink.

The yearly mean temperature at Abu-Naim must be about 88° F., viz., the same as that of the oases which are located in the northern part of the Sahara. The presence of the djef-djef formations, and the fact that in Abu-Naim, in the same latitude and at the same height above the sea level, "gerara"† are found, corroborate the assumption that Abu-Naim still belongs to the region of the Mediterranean rains. This region, therefore, extends much more south than meteorologists hitherto have believed.

At the time when we visited Abu-Naim the country did not look torrid and bare, though there had been no rain for over two years; on the contrary, our eyes enjoyed the view of beautiful palm shrubs and ethel thickets. Ethel (*Tamarix*) formed the most important part of the vegetation, and often we saw this tree grown to a great height. A peculiarity of the ethel is the fact that, when the shrubs are nearly buried in the sand, blown over them by the winds, they try to escape by growing out of it. So it frequently happens that hills, having the height of from twenty-five to thirty-five feet, upon which an ethel grows, are formed by the roots and branches of this plant, which are surrounded by sand. The palms of the oases are very seldom found singly; they grow together in groups, forming thickets. They are all wild and bear only small fruit; no one takes the pains to cultivate them. Of other smaller plants which are found, I mention especially the two camel herbs, agol (alhagi) and bel-el (*Anabasis articulata*), which cover large stretches of the ground. I also discovered kasbah (*Arundo phragmitis*), rhardak (*Nitraria*), and fers (*Traganum nudatum*). The first one is a kind of rush which grows everywhere where there is water under the surface; the other two are shrubs. These were the only plants that we found, though I doubt not that there are many more when the season is propitious.

Of large animals that live in this oasis, I mention gazelles and antelopes, of which we found traces on the ground. The rest of the mammals probably consists of rats, mice, fennegs, and perhaps jackals. I could discover no traces of hyena. Of birds, only sparrows, wag-tails, and a few ravens seem to be stationary inhabitants of the oasis. The swarms of swallow and a few storks which came in the evening to look in every bush for snakes, lizards, and other tid-bits, remained only one night, and then continued their flight northward. (Swallows often remain for several days in the oasis, where flies and gnats are abundant.)

Of other living beings we saw lizards, chameleons, snakes, and especially the poisonous horn viper, several kinds of ants, a great blue-black wasp, which builds very beautiful habitations and feeds its larvæ with caterpillars, and a butterfly (*Vanessa cardui*), which, in 1879, could be daily seen in the northern part of Tripoli and at the Mediterranean Sea, even far from the coast. This butterfly we found later in the terrible deserts between Cyrenaika and Kufa, hundreds of miles from this oasis. If we add to this a number of midges we will have the whole fauna of Abu Naim.

As already mentioned above, human inhabitants are not found in that region, and it may be said to be perfectly masterless.

EASY METHODS OF DETECTING BLOOD-STAINS.

By PROF. D. S. KELLICOTT, Buffalo State Normal School.

THE detection of blood-stains, in a medico-legal sense and for other purposes, is certainly a question of grave importance. In criminal cases experts are ordinarily employed, but it is a hard fact that these experts have various degrees of expertness. Physicians are often called upon to testify in court, either as experts, or to corroborate or destroy expert testimony; therefore, the plain obligation to acquaint themselves with the recognized methods, and the state of scientific and professional knowledge relating to this subject, and to get both a theoretical and practical acquaintance with these methods. Although I am neither a doctor nor a professional chemist, I undertake to state several easy methods of detecting blood-stains, and in your presence attempt to demonstrate their efficiency.

The questions presented are these, "Is a given spot or stain caused by blood, and if so, is it human or not?" two very distinct inquiries. To the first the examiner can ordinarily give a positive answer, obtaining his proof from one or all of these methods. 1. Chemical reactions. 2. Microscopic examinations. 3 Spectroscopic examination.

It is often of much consequence to be able to affirm that the spot in question is due to blood. To the second question, although of more consequence, unfortunately a less positive answer can be given. There is at present but one known method of approaching the problem, *i.e.*, by the size, shape and character of the corpuscles under the microscope, and when these are restored from blood once dried, many, I may say most, experts deny that these qualities are sufficiently constant to be decisive. The chemical and spectroscopic behavior of red blood after drying, derived from whatever source, is now held to be identical. I shall omit all consideration of the spectroscope in relation to this matter, except to remind you of Beal's statement that "the application of the microspectroscope to the detection of blood-stains has, on the whole, been most satisfactory; probably for the future this test will be that universally adopted." (*Mic. in Med.*) On the other hand Dr. J. G. Richardson says "that it is not so delicate as the microscope, and of no use in determining the kind." (*Med. Mic.*) I have too little practical acquaintance with this instrument to have an opinion. It seems to me that the microscope or chemical tests are sufficiently delicate for most cases, besides I incline to the plainest methods, yet after all, the nature of the case must determine what means shall be employed.

The easy chemical tests may be mentioned as follows:

1. Blood readily dissolves in distilled water, giving a reddish color. Blood dried upon iron and acted upon by the hydrated oxide of iron is insoluble in water. It dissolves, however, on adding citric acid. The undissolved threads of fibrine may be examined under the miscroscope and chemically tested. (Dissolves in acetic acid, colored by test liquid of Millon and Pettenkofer.)

2. To the solution in water add weak ammonia, no change of color, or at least no change to *crimson*, which excludes certain vegetable stains.

3. Boil a small quantity of the aqueous solution, the color is discharged and grayish flocculi appear in it from coagulated albumen; these disappear on adding solution of caustic potassa, the color becoming green by reflected light, red by transmitted light.

4. Obtain the hæmin crystals. This last reaction I consider very delicate, the crystals never failing to appear even when the quantity of dried clot is exceeding small; a fragment large enough to see distinctly is ample to afford scores of these characteristic forms. There are several methods of obtaining them, viz.:

1. Virchow's plan: The fragment is crushed, an equal quantity of common salt added. After thoroughly mixing, moistened with glacial acetic acid, covered and brought to boiling, or to dryness over the water bath.

2. Crush the fragment, add a drop of water holding a trace of common salt. I use one drop of a one-per-cent. solution to ten of water. Cover and so place a drop of glacial acetic that it will slowly run under, then heat over the water bath as before.

3. Boil the powdered blood with glacial acetic acid in a test tube and evaporate to dryness on a glass slip.

Other courses are prescribed, but unless the case is a special one, these, while simple, are entirely satisfactory. Reasonably skillful manipulation can not fail to give the characteristic, brown rhomboidal crystals, many lying singly, others in crosses or stars. There are no known crystals of other substances thus obtained likely to deceive a practiced eye. Different kinds of blood give similar crystals. They may be examined with a quarter. I prefer the first method named above, although the second gives the crystals more evenly distributed over the field.

The microscopical examination of blood-stains has received much careful attention, and this instrument of precision has in this field undoubtedly great possibilities; it has surely suffered on account of its friends, still I am not without hope, indeed I have the expectation that it may yet abundantly triumph. Is it not so that adverse opinions, as to its ability in these matters, arise more often from want of excellence in the glasses, or from want of manipulative skill in the operator than from the nature of the case?

The microscopic test depends mainly upon obtaining the corpuscles, red or white, or both; to determine whether or not it is mammalian upon their shape, size, melus, and if mammalian, whether it is human or not, by the size alone. There are several rules given us for restoring the corpuscles; the simplest and most rational are these:

1. Dr. J. G. Richardson's method: Crush a minute fragment under cover, focus upon a suitable piece, a thin edge, then slowly run under distilled water.

2. The same with a one-per-cent. solution of common salt.

3. The same with glycerine and water—specific gravity 1028, prepared by mixing four fluid ounces of water with three and one-half drachms of glycerine; some carbolic acid should be added if the mixture is to be kept for use.

After using each of the above fluids, I conclude that distilled water is quite as sure to give results as the others. To obtain red blood globules from a dried mass, sufficiently perfect for the determination of their characters, is not nearly so easy or sure as the books make it, and to get them so well that measurements differentiate the blood is of course much more so. Beal and Richardson mention high powers and glasses of superior quality as the necessary equipment for such work. My experience teaches that there is no use to try to do anything with this matter without high powers. I believe the very best objectives for the purpose are the modern four-system, sixth or tenth of the highest angle, and these in connection with solid eye-pieces.

Experimenting with human blood, dried in a mass on a glass slip, using a fairly good one-sixteenth inch objective, I obtained results as follows: 1. Every trial gave the lymph globules. 2. Every trial gave, after the color was well discharged, threads of fibrine. 3. One-half of the trials gave the red globules so well that I could declare that they were not from reptiles, fishes, or birds. 4. One attempt in five gave the red ones so satisfactorily, that some few could be measured with accuracy, and, by the way, my measurements of such (using the camera) came very near the standard size of these disks when dried in film on a glass slide. A series of experiments with dried snake's blood, using the one-eighth inch objective, gave rather more favorable results. When too much water was used, and the outline of the corpuscles were invisible, the nuclei were often seen in masses which were quite deceiving; under a quarter-inch objective they appeared quite like globules of another sort.

Is a stain due to human blood or not? I would not undertake to say in a case where any thing in particular depended upon it. I will not say that I think it doubtful whether those professing to be able to so determine are really able or not, but I can pretty safely say that the number who ought to attempt such determination are very few.—*Buffalo Med. and Surg. Journal.*

COTTON.

THE National Cotton Exchange of New Orleans give the consumption of cotton in Southern cotton mills the past year at 221,337 bales; of Northern mills at 1,573,997 bales—together 1,795,334 bales—out of a total crop of 5,761,252 bales. Other authorities make the Southern consumption 179,000 bales, but the aggregate is nearly the same for both sections. The home consumption is 31 per cent of the whole crop, as compared with proportions not much exceeding 25 to 28 per cent. heretofore. In 1878–9 the consumption was 1,561,933 bales in the United States in a total crop of 5,074,155 bales. The increased consumption is somewhat more than 15 per cent., which sustains the views generally entertained as to the growth of the cotton manufacturing industry, and establishes the fact that the last year was the best in its general activity for the last five.

The success of a few cotton mills in the Southern States, Mr. Edward Atkinson claims, does not prove that many mills could succeed at the South. It is probable that the wish is father to the thought, Mr. Atkinson's local interests being strong enough to bias his judgment.

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* "Sebcha" is the name for salt swamps, the surface of which has become dried out, but a few feet under the surface salt water and salt seas are found. "Djef-djef" is different from the former formation on account of the fact that, under the clods, no water is found, and the peculiar formation of the ground seems to have been caused by strong rainfalls.

† "Gerara" originally means a sack made of camel's hair or sheep's wool, serving for carrying the baggage of the travelers through the desert; but in this case it indicates cavities in the ground, which, after rain, are very fertile, and may be used for agriculture. Springs are not found in the gerara.